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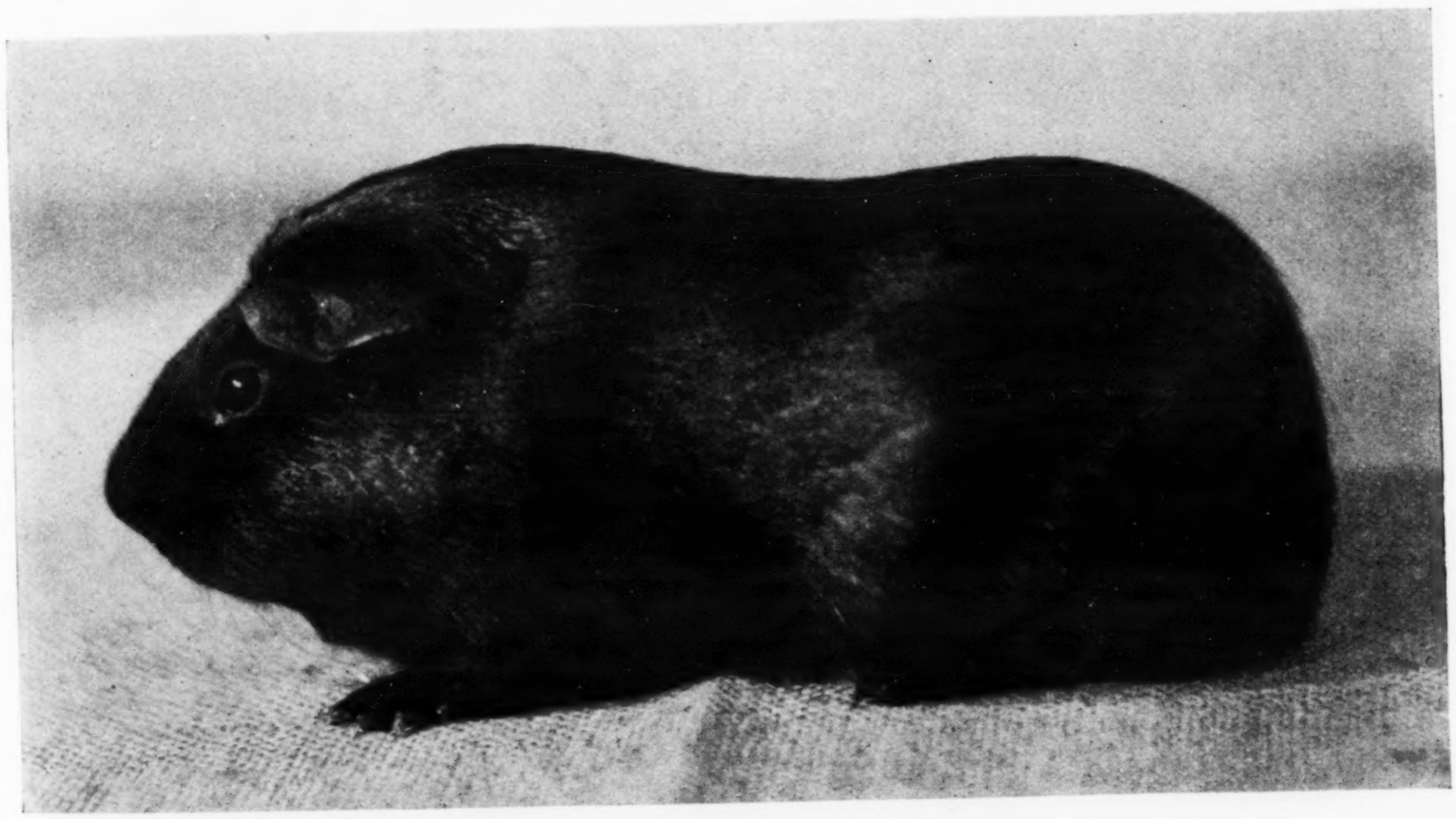

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Marriage Selection and Scholarship
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Paracelsus Vindicated

Pre-Darwinian Evolutionists

JUNE, 1927 Vol. 18, No. 6

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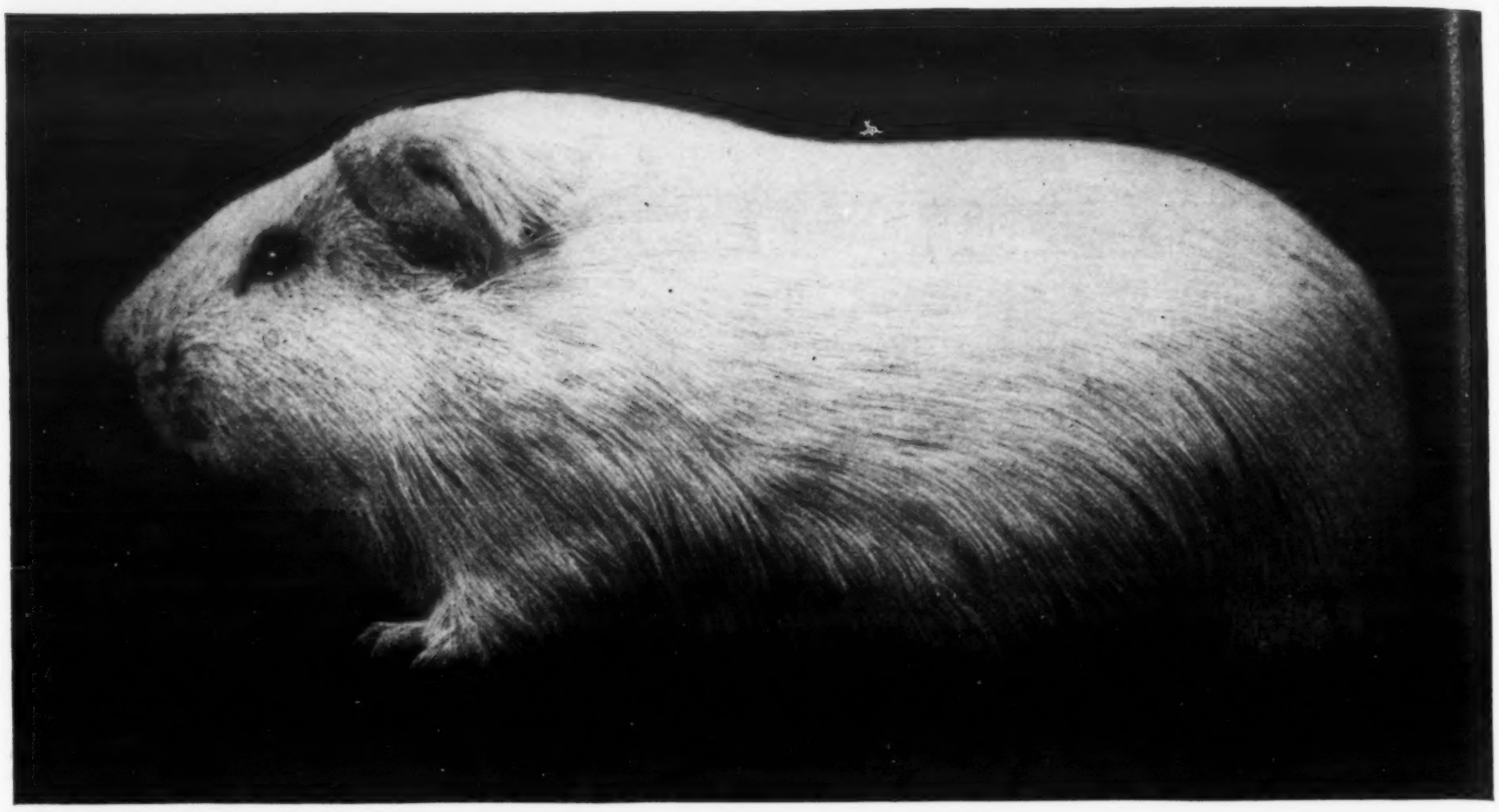


A SYNTHETIC "ALBINO"

With purer white ears than those found on the albinos usually shown by the fanciers, though it is not a true albino, its white color being due to a particular combination of recessive factors. The apparent pigmentation in the ears is due to the pink color produced by the blood in them. This animal was first in his class at a show held in Kansas City, Kansas, December, 1926.

A LABORATORY PRIZE-WINNER

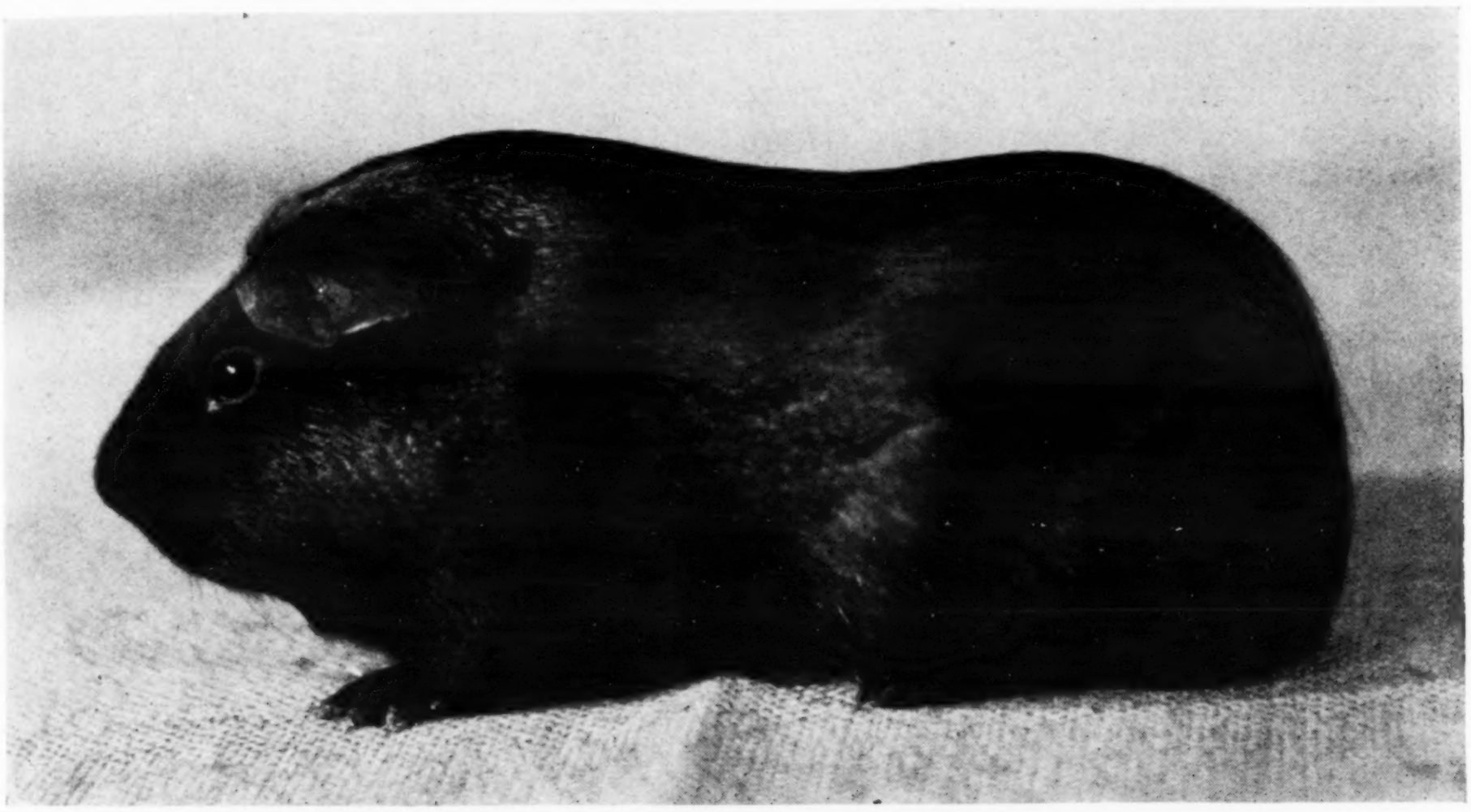
Frontispiece

Produced in our laboratory; a female who won first prize in her class in a show held at Kansas City, Kansas, December, 1926. From the standpoint of conformation, show-type animals should have "Roman noses," drooping ears, and a "crest" above the ears. With regard to color factors creams should be of the composition *CdCa ee bb f2f2*. *Cd* is a dilution factor incompletely dominant to *Ca* (albinism) which is at the same time responsible for the presence of red pigment in the hair. The combined effect of *e* and *b* is that chocolate (*b*) is not extended (*e*) throughout the coat and for this reason the dilute red hair shows. Because of *b* the ears have no black pigment in them and due to *f2* the dilute red (or yellow) hair fades into a cream.

GENETICS AND THE PRODUCTION OF SHOW TYPE ANIMALS

The Application of Scientific Methods to the Production and the Analysis of Show-type Animals, with Special Reference to Guinea-pigs*

HEMAN L. IBSEN
Kansas State Agricultural College



A UNIFORMLY PIGMENTED BLACK

Figure 1

A prize-winning self black male bought when young from a fancier. Its chief characteristic from the color standpoint is an intense pigmentation which extends to the roots of the hair. The ordinary laboratory black is more dilute at the base of the hair, and in crosses with fancy blacks produces offspring like itself, thus demonstrating that the factor (or factors) causing uniform intensity of pigmentation in black hairs is recessive in nature. At present all fancy chocolates have hair which is more dilute at the base than at the tip. The fanciers prefer an animal with hair of uniform intensity. It seems highly probable that such an animal can be produced in the F_2 of a cross between chocolates and show-type blacks.

SHOWS for the exhibition of animals or plants are quite common and in high repute in this country and in Europe. Breeders of livestock, for instance, consider it a great honor to win prizes at such shows as the International at Chicago and the American Royal at Kansas City. The increase in monetary value of the prize-winning animals and their offspring is also taken into consideration. Another fact of great importance in connection with shows is that when rightly conducted they tend to raise the standards of the various breeds exhibited and this in turn increases the utility value of the animals. It also makes possible greater improvement in non-registered livestock

*Contribution No. 83 from the Department of Animal Husbandry, Kansas State Agricultural College.

by the use of purebred sires produced for show purposes.

Genetic Methods in Breeding

It is undoubtedly true that great improvements have been made in livestock because of the competition for prizes at shows. However, very little advantage has as yet been taken of the newer knowledge and methods developed during the past twenty-five years in the science of genetics. At present our knowledge concerning the mode of inheritance of definite characters in our higher domesticated animals is still very meager and this in itself to some extent prevents the breeder from making much use of genetic science, but on the other hand the knowledge of genetic *methods* is far enough advanced to be very useful. By the use of genetic methods more facts could be learned concerning the mode of inheritance of specific characters, and the desirable combinations of characters could be effected without necessarily determining how they were inherited. The present method of the practical breeder consists of the mating together of superior animals, with the realization that at least some of the offspring generally will be equal to or superior to the parents. This is more apt to be true if the two parents happen to "nick" satisfactorily, by which is meant that the offspring tend to combine in themselves the desirable qualities of both parents.

Our higher domesticated animals reproduce rather slowly, are expensive to work with, and for these reasons are not so suitable for experimental work as are for instance the rodents. The latter, chiefly rabbits and guinea-pigs, are often exhibited at "pet stock" shows, and consequently offer good material for the study of the inheritance of show type characteristics.

"Synthetic" Prize-Winners

The "standards" for guinea-pigs and rabbits, however, differ somewhat from those for our higher domesticated animals. With the latter, "utility" is largely taken into consideration, and this is based to a considerable extent on conformation, while with the former, especially guinea-pigs, color and ear carriage are the chief considerations. For these reasons results obtained with the smaller animals are not directly applicable to the larger.

During the past few years I have been making genetic analyses of show-type guinea-pigs and rabbits. The work with the rabbits has been in progress for a shorter period and as yet does not warrant a detailed discussion. A number of rather interesting results have been obtained with guinea-pigs, however.

The usual method has been to buy some show stock, and to verify its prize-winning abilities by sending it to one or more shows. Later, appropriate matings are made to determine the crucial hereditary factors involved. A few examples will serve to illustrate the methods used.

Several years ago a trio of "creams" was bought from two different breeders. It was noticed that those from one breeder were slightly darker than those from the other. No attempt was made to study the inheritance of this difference at the time, but instead creams were mated to each other and to yellows, which are too dark to be of the show-type color, with the idea of determining the inheritance of the main factor. It was found that the creams, like the yellows, were dilutes, heterozygous for albinism (*CdCa*) and in addition carried a recessive "fading" factor (Frontispiece). As a result they are yellow at birth and gradually fade into cream.* Matings are now being made to determine the inheritance of the factor (or factors) causing the slight difference in creams. The indications are that it is a modifying factor affecting the expression of the fading factor which in

*The fading factor described by Wright (1923, *American Naturalist*, Vol. 57, pp. 42-51) is more pronounced in its effect. It reduces "red to a yellow, which fades later to cream and even white." Since Wright uses the symbol, *f*, to designate his factor it has been decided to use *f2* to indicate the one herein described.

turn modifies the expression of yellow.

The coat colors of other show type animals, such as blacks (Figure 1), chocolates, reds and agoutis, are being studied in a manner similar to that used for creams, and in addition the inheritance of the variation in the length of hair in the long-haired breeds is being investigated. No systematic attempt is being made as yet to determine the inheritance of the fancy points in the conformation, although there are indications that the desirable droop to the ears is due to a recessive factor.

Besides making the above genetic analyses of known prize-winners, it has been found possible to produce in the laboratory, by the proper combination of factors, animals which are equal to or even superior to animals produced by the fanciers. The best example of this is the "synthetic pink-eyed white" (Frontispiece). The whites exhibited by the fancier are albinos, although it would be more correct to call them Himalayan since there is generally a varying amount of pigment in their ears. The standard, however, calls for pure white ears. The synthetic pink-eyed whites are genetically not albinos (or Himalayan) but are due to a definite combination of recessive factors. They are pink-eyed (*p*), lack red (*Cr*) and black (*B*-black, *b*-chocolate) and in addition the chocolate (*b*) is found only in the skin of the ears and the feet (*c*-non-extension of black or chocolate). The pink-eye factor, however, dilutes the chocolate to such an extent that it is practically not noticeable in the ears or feet. Since there are only three pigments in guinea-pigs, (black, chocolate and red) and since these are either absent or invisible, the coat and skin are a pure white, and due to the pink-eye factor the eyes are pink. Animals of the above composition, with the conformation also as nearly perfect as possible, have been shown several times and almost invariably have won first prize. When they were not first it was due to deficiencies in conformation. Similar experiments are now in progress to produce superior chocolates, blues and agoutis.

I think enough evidence has been given to demonstrate that in the production of show-type guinea-pigs the breeder with a knowledge of genetics has an advantage over breeders lacking this knowledge. Even if this phase of the experimental work were not taken into consideration, the work would nevertheless justify itself because of the many new hereditary factors brought to light by this means. There seems to be no reason to doubt that the use of similar methods with our higher domesticated animals will lead eventually to the production of proportionally more animals of the desirable type and possibly to the production of animals superior to any now in existence. The art of breeding has gone very far, but the science of breeding will be of assistance in going farther.

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A HILLSIDE TOMATO GROWER OF THE BALEARICS

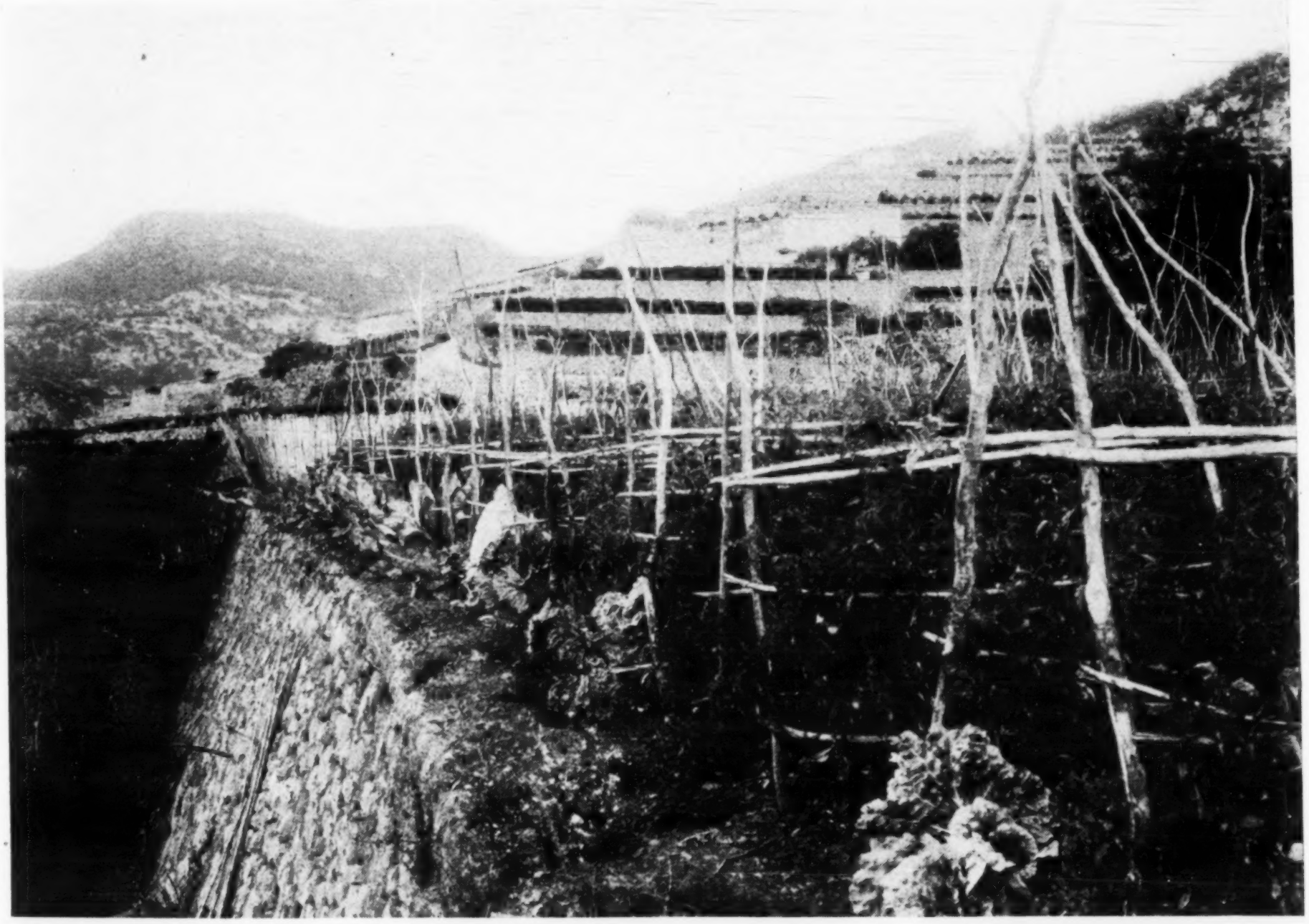
Figure 2

A single "string" of the "De Ramallet" Tomato held up by one of the veteran tomato growers of Bañalbufar. There are about ninety fruits in this string, and during the season over seven hundred men and women are busily engaged in making them and hanging them up to dry. C'an Pico Estate. Photograph by David Fairchild.

THE TOMATO TERRACES OF BAÑALBUFAR

An Agricultural Monopoly Built on a Single Variety of Tomato*

DAVID FAIRCHILD



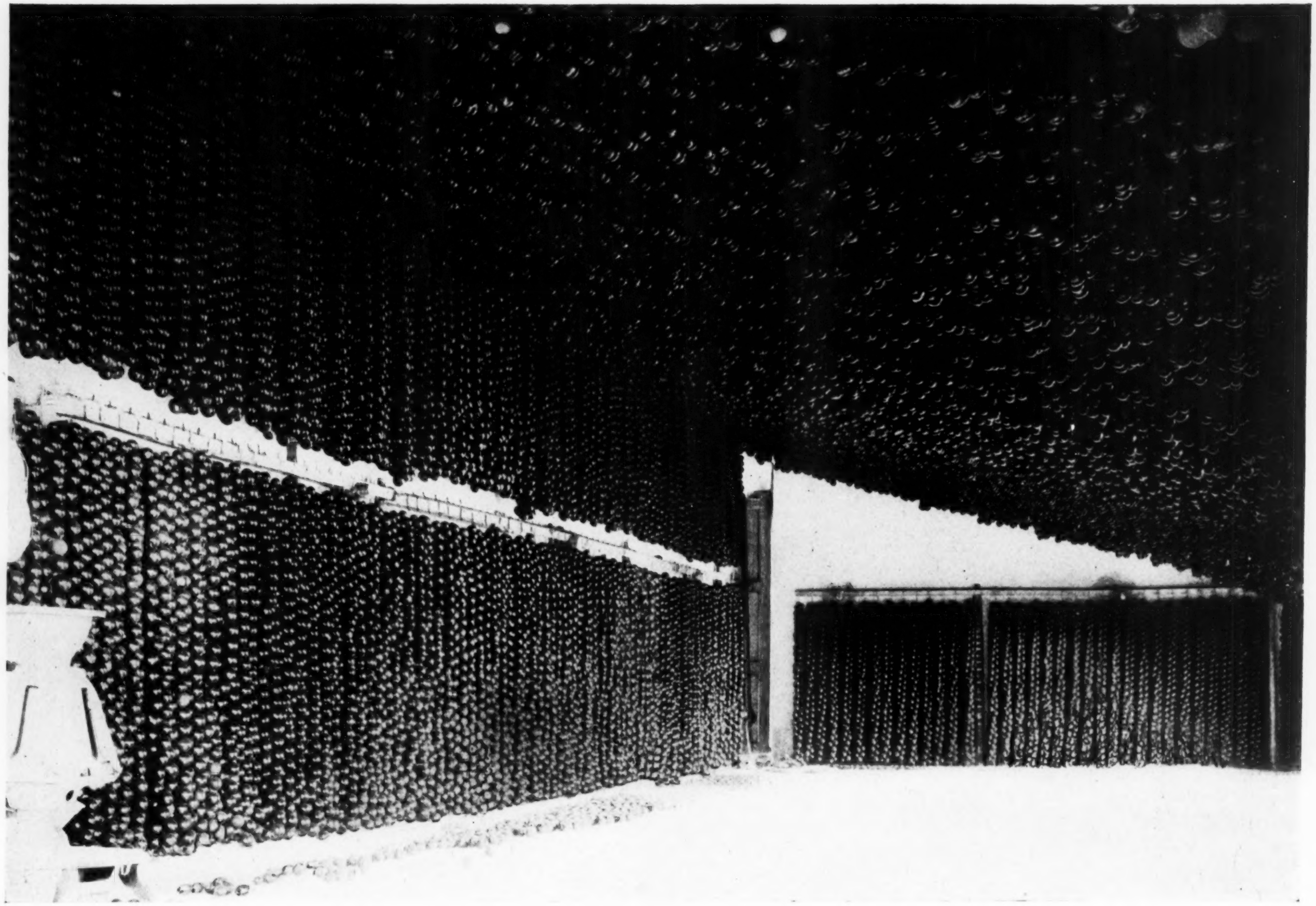
THE TOMATO TERRACES OF BAÑALBUFAR

Figure 3

Showing millions of tomato plants of one single variety grown on trellises. The terraces have been built at an incredible expense of hand labor and they cover the whole hillside for miles on the north end of Majorca, one of the Balearic Islands. Concrete reservoirs hold the irrigation water which is distributed to the terraces by an elaborate system of canals. Photograph from C'an Pico, by David Fairchild.

FEW things are more surprising to an American visiting the Mediterranean region than the stone-built terraces which, like steps, cover the sides of the hills from the sea to the very tops of the mountains, As evidences of back-breaking labor what has the American farmer to show in comparison? His rolling fields cleared of trees and brush, his neat stone walls, his barbed wire fences, his barns and silos appear to be the work of a few years of activity and they pale into a kind of vague insignificance when one compares them with the carefully laid retaining walls of stone which aggregate

*Plant Introduction Contribution from the Allison V. Armour Expedition of 1925-1926.



DRYING ROOM FILLED WITH "DE RAMALLET" TOMATOES

Figure 4

Over 100,000 tomatoes hung on threads in a drying room at Bañalbufar. Although the thread which strings these tomatoes to the wall and rafters is passed through the delicate stem of each tomato, remarkably few of the fruits actually loosen from their stems and fall. On the floor are shown those which have fallen. I have never seen such a mass of brilliant [illegible]

Figure 4

Over 100,000 tomatoes hung on threads in a drying room at Bañalbufar. Although the thread which strings these tomatoes to the wall and rafters is passed through the delicate stem of each tomato, remarkably few of the fruits actually loosen from their stems and fall. On the floor are shown those which have fallen. [illegible] Photograph by David Fairchild.

TRELLISES OF CANE

Figure 5

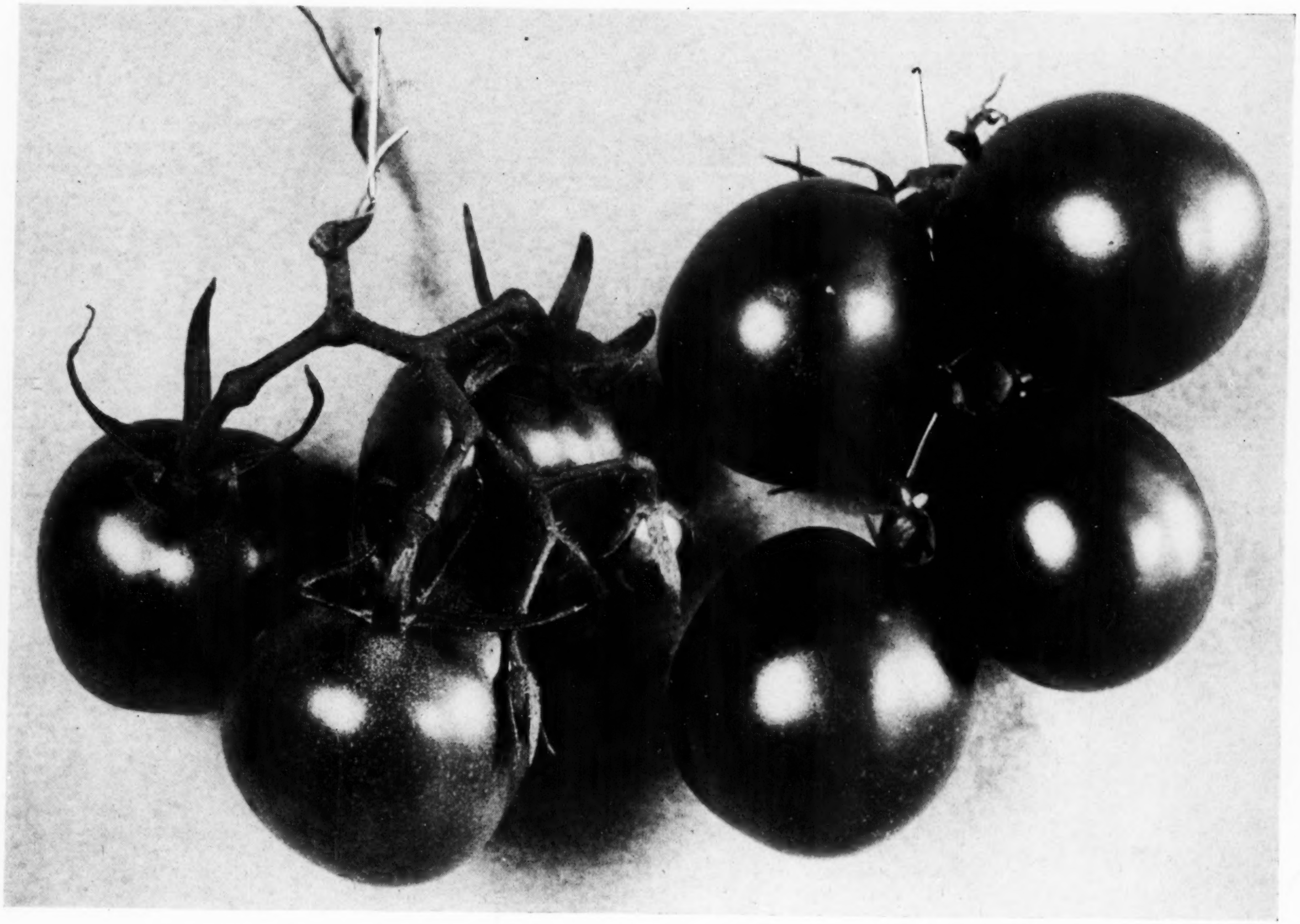
The tomato of Bañalbufar is grown on trellises made of the common cane. *Arundo donax* and appears to be remarkably uniform in growth and other respects. It is a superb looking variety. Photograph by David Fairchild.

hundreds of miles in length, as they are spread before one against the mountain sides.

Let anyone who has never considered this phase of the agriculture of the great Mediterranean basin start his experience by building a hundred feet of stone wall eight feet high and four feet through at the base! Let him try to do this on a mountain slope so steep that when the stones fall from his hands they roll down the hill into the valley, and let him make this wall so well that although he fills in behind it hundreds of tons of earth it will last for a dozen centuries or more. He will then begin to realize what terraced agriculture means in the way of hard physical labor. The stone walls of New England, where the stones from the fields have been stored to get them off of the land, approach, in their evidence of hard work, in but a very feeble way that furnished by this agriculture of the Mediterranean hillsides.

Two incidents recently served to rivet my attention on this feature of terrace agriculture. I was calling on Admiral Cotton, in command of the Fortress of Gibraltar, and he showed me his garden over which he is as enthusiastic as a child, being a true plant lover. He explained that he was remaking his terraces and I saw the men at work with long levers and shovels trying with all their might to remove from the bottom of one of them a great boulder which took the place of the same amount of good fertile earth which he wished to place there. The removal of this single boulder must have absorbed the time and the wages of three men for at least two days.

A little while later I was riding down the side of one of the Barrancos of the Island of Grand Canary. It was dusk,



METHOD OF STRINGING DE RAMALLET TOMATOES

Figure 6

On the left is shown a cluster of three tomatoes, as they grow on the vine. At the right are four tomatoes threaded on a string by their stems, as is done in drying them. Two outstanding characteristics of the variety are the remarkable uniformity in size and shape of the fruits, and their adherence to the stems, which makes it possible to dry

but through the gathering twilight I saw a group of four men at work just below a stone wall. They were old men. Two of them were trying to excavate a large boulder which they wanted to place in the wall above them —the retaining wall of a small terrace not over a quarter of an acre in extent. The other two were carrying boulders from the hillside and placing them in the wall. I do not know how long they had been working at this wall nor how late into the night they continued their labors, but when I reflected on the smallness of the parcel of land which they were reclaiming for banana culture it was difficult for me to imagine any land in America, short of "Florida real estate," which could return interest on the cost of such work. Of course it would be a fallacy to think that these evening hours of the old men had any money value which they could get cash for; they worked because they wanted more banana land. They were too old ever to reap much profit from it, but by one of those interesting laws of life they were building a wall which would remain as a vastly more lasting and impressive monument to their lives than anything which their relatives would ever erect in their honor after they died. I can not help comparing these useful terraces — undated and unnamed as they are—with the hideous carved stone mausoleums of the Campo Santo in Genoa. Who, on second thought, would not prefer to be remembered by a terrace on which fig trees or bananas were growing than by some perfectly useless monument in some ghastly city graveyard which gives nothing but the dates of birth and death?

Terraces to the Mountain Tops

It was with some such reverence for terraces that I set out one day in August for Bañalbufar accompanied by Professor W. M. Wheeler of Harvard and my son Graham, and having as guide Dr. Porcel of the Port of Palma, which is the chief city of the Island of Majorca, one of the Balearics.

As Wheeler and my son were in quest of insects and I was bent on seeing tomatoes, we parted company before we reached the wonderful terraces of Bañalbufar which lie on the north coast of this largest of the Balearic islands.

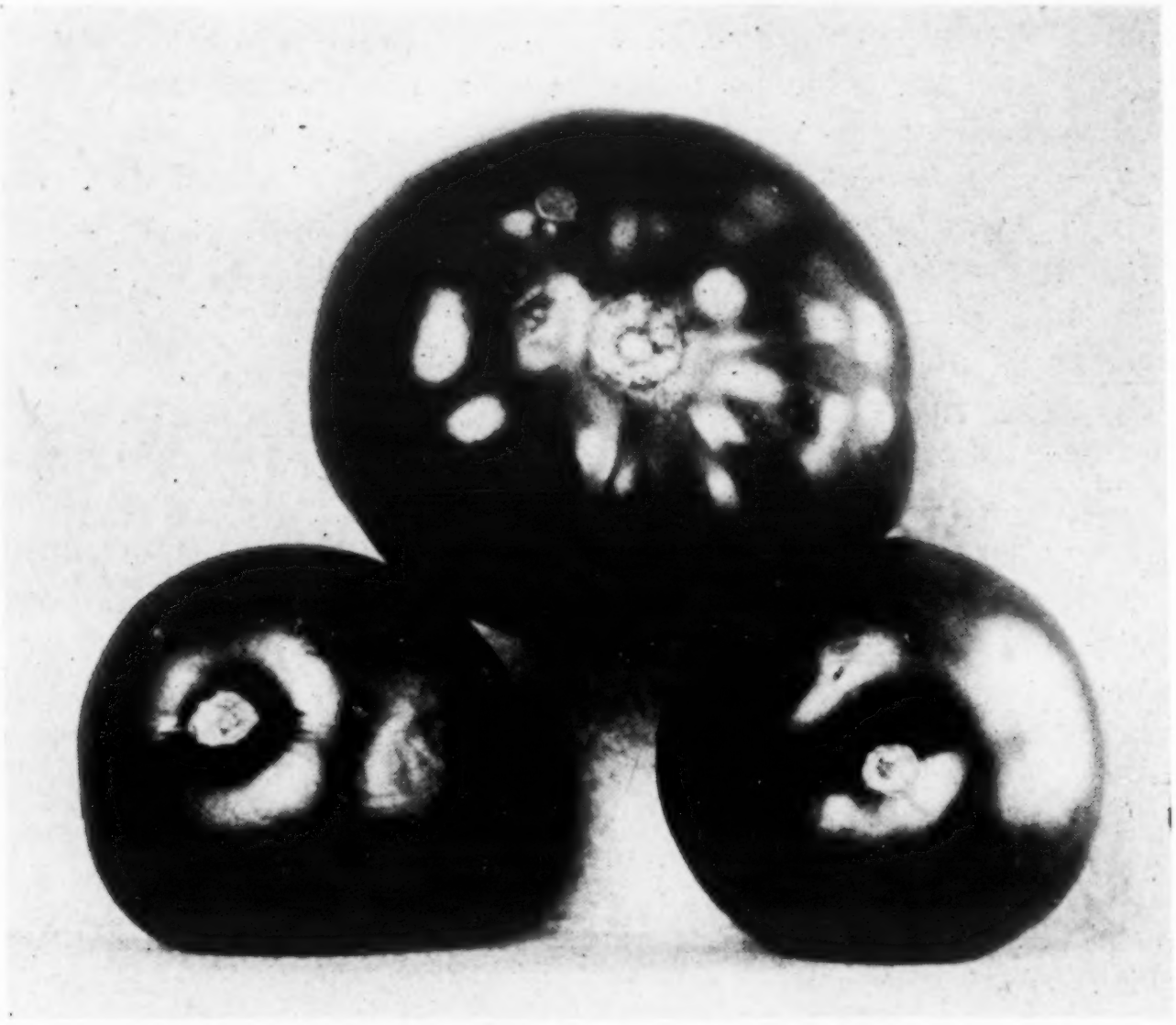
The doctor had talked enthusiastically of those terraces for some time but I had no idea of what they were like. I had seen tomato fields before. I remember one which covered a thousand acres or more of land south of Miami from which the perfectly green fruit was gathered by the train load and sent to the New York market. I remembered all too vividly the piles of rotting fruit by the roadsides. As we walked along, suddenly, extensive terraces came into view around the hillside. They covered the whole north end of the island as far as I could see and stretched from the sea coast up to the cloud-covered mountain top. They were amazing in their neatness; their walls were often ten feet high and as well made as the walls of many houses. Tanks of cement construction reflected the sky from the water which they contained and canals leading from them to the terraces evidenced how completely the whole culture was dependent upon irrigation.

Tomato Drying-Houses

Here and there well-built houses and outbuildings were seen . We approached one of these buildings and as we passed I peered inside. The sight was startling — curiously overwhelming. The room was low and the sunlight streamed into it from two small windows. The walls were brilliant red and the ceiling too, was a deep red, in fact the whole atmosphere seemed to be filled with color; the color of a ripe tomato. As my eyes became accustomed to the fainter light of the room I saw that the walls were hung with strings of tomatoes which reached from the ceiling to the floor and that these were as regular as any strings of giant beads could be. What I had taken for the red ceiling was a solid

Figure 6

On the left is shown a cluster of three tomatoes, as they grow on the vine. At the right are four tomatoes threaded on a string by their stems, as is done in drying them. Two outstanding characteristics of the variety are the remarkable uniformity in size and shape of the fruits, and their adherence to the stems, which makes it



VARIATION IN SIZE

Figure 7

Three tomatoes of the "De Ramallet" variety showing what appeared to be the maximum variation in size and shape as grown on the terraces of Bañalbufar. I was informed that this variety was discovered somewhere in the forest of the island of Majorca about seventy years ago by a man who lived to see its cultivation become a great industry—dying only a few years since. Seed of this variety bears the S. P. I. number 65023. Natural size photograph by Allison V. Armour.

mass of these same strings of tomatoes hung so close together that I could only see their lower ends. The strings were three feet long and nearly touched one another as they hung from the special rafters above.

In one corner of the room sat a man stringing tomatoes with a needle and thread. He deftly passed the thread through the green stem of each fruit—not through the fruit, as I at first thought. Those which he strung were not quite ripe but were turning red. He informed me that he strung 90 fruits on each string—30 on each thread and three threads to the "chapalet," so to speak.

I once tried to hang some tomatoes at my place near Washington and ripen them as I had seen them ripened on the walls of the houses in Naples, but with disastrous results. They fell off in showers and they decayed so fast that the only impression of the experiment which is left on my mind is a red, tomato-smelling, disgusting mess. Remembering my experience I looked on the floor to see the rotten tomatoes there and was astonished to find only a few soft ones scattered about. There were over 100,000 tomatoes hung in the small room and I don't think there were more than 50 on the floor. One hundred thousand tomatoes hung up in a room by their small stems being strung on a thread and only 50 had loosened and fallen! This fact struck me as remarkable and required an explanation.

A Community Industry

During the afternoon which I spent at Bañalbufar I visited various grow-

ers and discovered that there were over a thousand men, women, and half-grown children engaged in stringing the fruits of a single variety of tomato. The fruits are about the size of the largest marbles which manufacturers make for boys to play with. They are remarkably uniform in color, and in the texture of the skin. The stem is firmly fastened and strong enough to support the tomato during the process of drying. These partly dried strings of tomatoes are shipped to Spain and the proceeds of their sale represent the only source of cash income for the little community.

The Tomato Terraces of Bañalbufar represented, in other words, a small manufacturing plant employing several thousand people who were living all over the hillside surrounded by their tomatoes, instead of in tenements in the center of some city. They were turning out a standard product and they were maintaining its excellence by careful selection of the plants from which they took their seed. And this was all being done without the use of any kind of mechanical device whatever. It was a keen pleasure to see hundreds of thousands of neatly trained tomato vines strung out on the terraces and held up by trellises of sticks and native cane with nowhere any sign of a wire.

These conditions are maintained by sheer dint of hard work and the discipline and skill and intelligence of a group of hardy people who, because they are dependent upon the sale of these strings of tomatoes, are obliged to work hard and teach their children to do so. It was in strong contrast with the flabbiness that one sees so much of in the great cities of Europe and America, and it gave me a thrill of pleasure.

Here was a kind of country-side monopoly maintained because of the peculiar climatic conditions, combined with the maintenance of the purity of a single variety of plant which, though far from its native home in South America, had become perfectly adapted to the environment and since 1870 had borne the same kind of beautifully colored, fine flavored fruits.

Had there been time to study deeper into this interesting situation at Bañalbufar I have no doubt but that many arguments would have been found supporting the idea that in any civilization such rural monopolies as is this are deserving of special consideration on the part of statesmen and should at all costs be maintained. It is from such spots as this that a supply of conscientious workers comes, without which no people seems likely to maintain its standing among the nations.

The Tomato Terraces of Bañalbufar represent more than simply "a lot of tomato growers" who make their living growing tomatoes on the hillsides of the Balearics. The industry is a very complicated and a very important human achievement, based, in the last analysis, upon the maintenance through continual selection by intelligent horticulturists of a standard strain of tomato which is peculiarly fitted for a special purpose.

Spaghetti with tomato sauce will never have quite the same meaning to me again for I shall see in my imagination the splendid Tomato Terraces of Bañalbufar and the fine race of horticulturists who have maintained them through all the years.

A New Book by Kammerer

DER ARTENWANDEL AUF INSELIN UND SEINE URSACHEN ERMITTELT DURCH VERGLEICH UND VERSUCH AN DEN EIDECHSEN DER DALMATINISCHEN EILANDE, by PAUL KAMMERER. Publisher: F. Denticke, Leipzig and Vienna, 1926.

The purpose of the late Paul Kammerer's book is to give a zoo-geographical analysis of the species and varieties of lizards collected on the islands and rocks (scogli) of the Dalmatian sea. The book deals primarily with the environmental factors influencing color,

pattern, size and other characteristics of these lizards. This part of the book contains many biological data which may prove valuable to the student of systematics and ecology; the critical estimation of these observations and their interpretation must be left to the specialist. Kammerer arrives at the conclusion that the isolation on islands has only a protective influence on the variation; but he thinks that this influence becomes effective even before the islands are entirely separated from the continent. He assumes that specific peculiarities of the climatic conditions on islands account for the selection in definite directions and thereby for the appearance of varieties typical for islands. However, in addition to his descriptive data, Kammerer reports on experiments which in his opinion support the conclusions concerning the change of species on islands from which he had drawn his material. The geneticist will be particularly interested in this experimental evidence. Kammerer tells us that he studied the influence of different temperatures, of increased temperature combined with abnormal dryness or with abnormal humidity, of humidity alone, of decreased intensity or changed quality of the light on the pattern and color of different species and varieties of lizards. Kammerer, however, does not give a description of the methods useds in these experiments nor a detailed account of their results. The reader will search in vain for a single remark concerning the number of animals employed in the experiments or for a presentation of the response of the single individuals under the experimentally changed environment. Instead, Kammerer contents himself with making generalized statements about the outcome of his experiments. Thus he leaves to the reader no possibility of forming an independent opinion. This is the worse since Kammerer's results are contradictory to all data obtained by other investigators in comparable experiments. Kammerer reports, for instance, that *Lacerta serpa, L. lilfordi, L. oxycephala* and certain populations of *L. muralis* became black after having been kept for one and a half to two years at a temperature of 37-40 degrees C; that *L. fiumana* under corresponding conditions changed its color from "leek green" to olive, brown or grey. He reports that the same temperature combined with excessive dryness produced the same process of darkening in a shorter time, that vice versa the rate of darkening was reduced by abnormal humidity. In *Lacerta muralis* this process of darkening is said to become effective primarily by an extension of the dark pattern, in other species by the formation of new pigment in the general body color. The application of high temperature alone is said to have the tendency of acting more in the first way, the use of high temperature combined with dryness more in the second way. Kammerer states furthermore that such animals brought back to the normal conditions of their natural environment and mated there, produced offspring showing at first the normal coloration, but then undergoing all the degrees of darkening and change of color through which their parents had gone under the experimental conditions. The inheritance of acquired characters has been proven once more! Of course, nobody can be expected to accept such statements as correct unless a detailed and convincing account of the experiments is given. Even an authority less doubted than Kammerer must realize that such a truly unscientific way of presentation can have as result nothing but a discrediting effect. Remarkably good color plates showing the species of lizards found on the islands are attached to the book. The experimentally changed lizards and their offspring are not depicted.

Walter Landauer.

MARRIAGE SELECTION AND SCHOLARSHIP

Among the Alumnae of the University of California

J. S. Bolin and S. J. Holmes

THE present paper is concerned with an attempt to investigate the working of sexual selection within a limited and relatively homogeneous group composed of the women graduates of the University of California. The only characteristic which was studied in relation to sexual selection was scholarship. It would be desirable, if data were available, to ascertain how the marriage rate is affected by health, temperament, racial extraction, and beauty, but adequate records, except perhaps in relation to health, are not available for such a study. Scholastic grades, as several recent investigations have shown, afford at least a rough measure of intelligence. It would be of interest, therefore, to ascertain what relation, if any, they bear to the prospects of marriage.

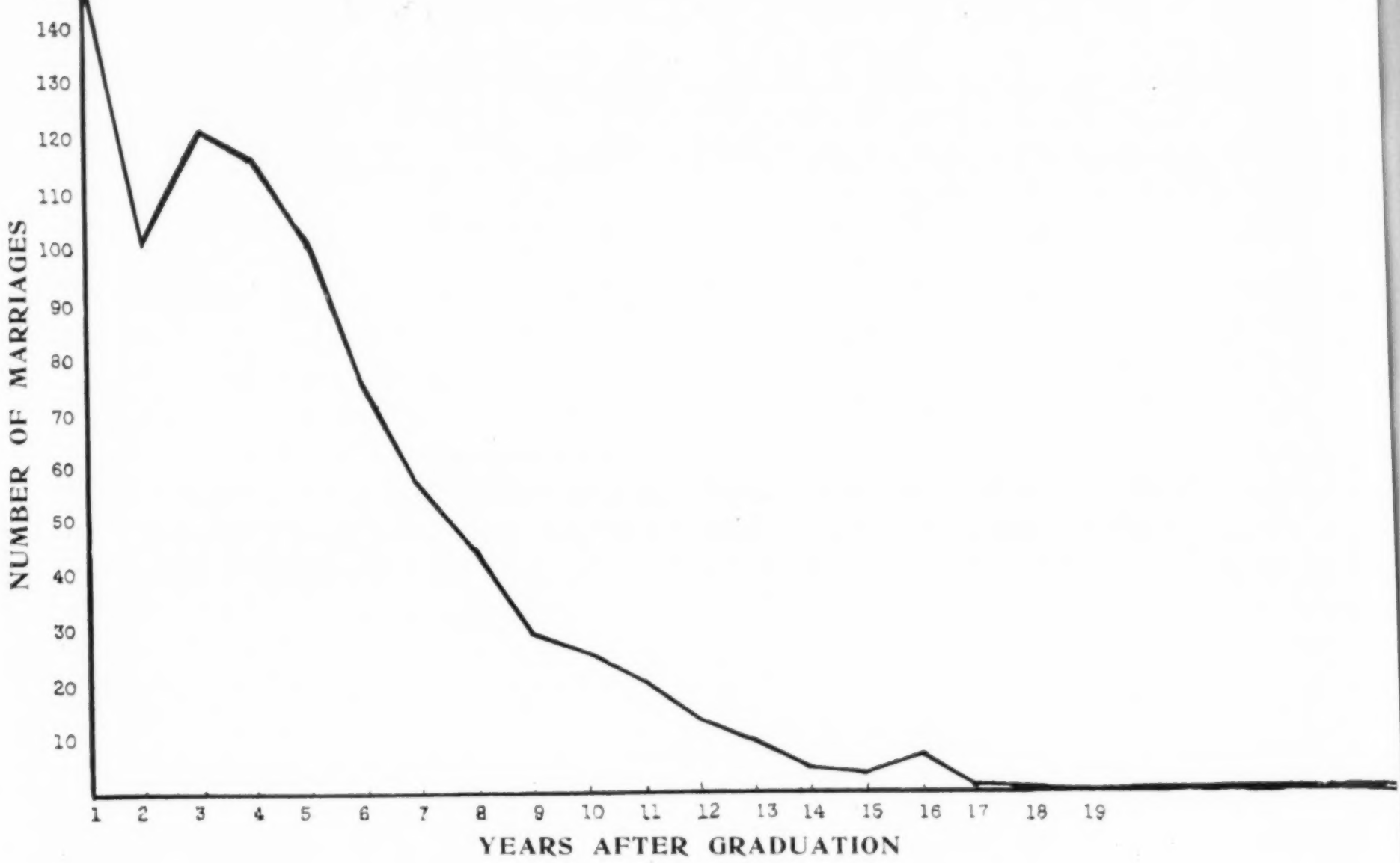
Data on the marriage of the alumnae were obtained from the records of the office of the Alumni Association, which were generously placed at our disposal. All of the records of women graduates were compiled from the earliest classes down to and including the class of 1910. Data on later classes were not included because of the likelihood of some marriages still taking place. A few marriages may occur also among those graduating before 1910, but the number would be so small as to be practically negligible in a statistical study. The entire list includes only sixteen alumnae, a little over one per cent of those married, who were married sixteen or more years after graduation.

The scholastic grades were obtained from the records of the Recorder's office, to which we were kindly given access by the Recorder, Mr. James Sutton. A number indicating the student's scholarship was computed by reducing all the marks to a system of numerical grades, 1, 2, 3, and 4, counting the number of 1's, 2's, etc., and taking the average of the sum. The average numbers for the scholastic records lay between 1 and 4, the smaller numbers indicating the higher grades. There have been some changes in the system of grading in the period covered by our data, and too much reliance should not be placed on the changes in the average scholarship of successive classes. Most of our comparisons have been made between persons belonging to the same class, or to members of a few successive classes under the same system, so that changes in the method of recording grades or in the severity of grading would have little effect upon our results.

From the class of 1874 to the class of 1910, inclusive, we obtained records of 2074 alumnae of whom 1160 were married and 914 were unmarried. The percentage that married is, theretore, 55.93, a figure which is much the same as those for the alumnae of several other universities and colleges. While there will still be a few additions to the list of the married, it is very unlikely, in the light of what is known of the trend of the alumnae marriage rate, that the additions will increase the ratio by more than 2 per cent. Sixty per cent of marriages is a fairly safe outside limit.

Chances of Marriage Equal

How do the scholastic records of the married and the unmarried compare? It was suspected, at least by one of the writers, that the graduates with the lower records would be the



MARRIAGE AND GRADUATION DATE

Figure 8

The graph shows the number of graduates marrying plotted against the number of years after graduation in which the marriages took place. The first year was the most popular, with 148 marriages, with a decline the year following, and a new peak the third year. The average date of marriage was 4.6 years after graduation.

ones most apt to marry, but a compilation of the whole series of grades shows that there was no basis for this surmise. The average grade for the married alumnae (1878 to 1910) is 2.017, while that for the unmarried is 2.009, giving a non-significant difference of 0.008 of a point. A comparison of the records of the married and the unmarried by classes showed that the advantage lay now with the one and now with the other.

An attempt was made also to answer the question whether among the married alumnae those with better scholarship tend to marry sooner or later than those with poorer records. For this purpose, the material was divided into sections and coefficients of correlation were calculated between scholastic grades and the intervals separating dates of graduation and marriage. If such a correlation proved to be negative, it would mean that the better scholars tend to marry later, on the average, than the poorer ones. In calculating the coefficients of correlation between scholarship and date of marriage, we began with the year 1898. The correlations for the several periods are as follows:

Correlation Between Scholarship and Interval Between Graduation and Marriage

Class	*No. of Married Graduates*	*Correlation*
1898-99	79	+0.022±0.076
1900	36	—0.025±0.113
1901	61	—0.051±0.086
1902	60	—0.053±0.087
1903	84	—0.015±0.074
1904	97	+0.005±0.069
1905	77	—0.031±0.077
1906	84	+0.077±0.073
1907	72	—0.104±0.079
1908	92	—0.111±0.069
1909	69	+0.107±0.080
1910	64	—0.176±0.082

It will be seen that the correlation is sometimes positive and sometimes negative, and that in every case it is very low. In most cases it is less than its probable error, and in only one case does it come near twice that figure. Taking the whole series together from 1898 to 1910 inclusive, the correlation becomes $-0.0327 \pm .023$. Evidently, therefore, there is no significant relationship between scholastic record and the duration of the single state after graduation from college, at least so far as the alumnae of the University of California are concerned, between the years 1898 and 1910.

The Phi Beta Kappa Marriage Rate

A special tabulation was made of those alumnae who became members of Phi Beta Kappa. Of those graduating between 1880, the date of the earliest members, and 1910 inclusive, there were 41 married and 34 unmarried. A separate list was made of the members of Phi Beta Kappa graduating between 1910 and 1915, although it is probable that a few of these may still marry. Twenty-seven of this list were married, and 32 unmarried. The totals from 1880 to 1915 were 68 married and 66 unmarried, giving a ratio of 50.74 per cent married, which is but little less than that of the alumnae in general and probably will equal it on account of the occurrence of a few marriages in the classes 1910 to 1915. This is a higher rate than has been reported for members of Phi Beta Kappa from Wellesley College and a few other institutions.

We are acquainted with but one other attempt to study the relation of marriage selection to scholastic rating or any other measure of intelligence. This is a study mentioned in Popenoe and Johnson's "Applied Eugenics." It was carried on by Miss C. S. Gilmore on the records of the class of 1902, Southwestern State Normal School, Pennsylvania. Miss Gilmore found that the girls highest for beauty tended to marry first, as is quite natural, and also that there was a tendency, though less decided, for a higher percentage of the more intelligent girls to marry also. No data are given on the numbers of graduates involved, or on the precise relation between scholarship and marriage rate. As the data were confined to a single class in an institution not of very large size, it is probable that the results were not statistically significant.

The married alumnae married on the average 4.6 years after graduation. The largest number of marriages took place the first year after leaving college. Then there was a drop with a rise attaining its maximum in the third year, after which there was a gradual decline. The members of Phi Beta Kappa married on the average 4.6 years after graduation, like the rest of the alumnae.

A Homeless Age

"Marriage," said John Haynes Holmes in the third and last of a series of sermons on that subject, "may be likened to the Cheshire cat in 'Alice in Wonderland'; it is gradually disappearing; nothing much remains of it except the smile—the cynical smile with which we discuss marriage in our time."

His announced topic was "Has Mar riage Any Future?"

It had a future, he said, but there was doubt whether it would be one of evolution or devolution. The changed position of woman from a "sex creature" into a "full-fledged human being" and the removal of education from the home to the schools, he declared, had so altered the conception of the home that "the home is left without an excuse for existence."—*Washington Star.*

A STRANGE COMBINATION OF CHARACTERS

Figure 9

A hybrid between cabbage and Brussels sprouts which was unlike any other plant raised from this cross. It is nearly three times as tall as the parent, and the "sprouts" on the stem have leaves as large as those of a cabbage.

A UNIQUE CABBAGE HYBRID

One Plant of Brussels Sprouts × Cabbage Cross Exhibits Unusual Combination of Characters

C. MOLDENHAVER
Poznan, Poland

AMONG the numerous hybrids, obtained out of a great number of crosses between the different forms of the cultivated Brassica, one especially deserves to be noticed and I take this opportunity to describe and present an illustration of it.

I obtained this plant out of one of the nine crosses between Brussel sprouts and the ordinary white cabbage, made in 1922 in the experimental garden for genetics and plant-breeding of the University of Poznan (Poland). The Brussel sprouts plant was the maternal parent and belonged to the variety, known in commerce under the name of "Hercules" which measures in full growth between 20-27 inches in height. I used as the male plant a white cabbage of the "Brunswick" type. The Brussel sprouts was pollinated with white cabbage pollen on May 12, 1922. The hybrid was successful, and I collected a certain number of seeds on July 20, 1922.

In the Middle of March, 1923, I sowed the greater part of these seeds in the hothouse. The first generation (F_1) progeny transplanted outdoors, consisted of a good number of plants, showing partly a feeble development, and partly a complete shrinkage of the side sprouts, excepting one specimen. From the beginning of its development this plant presented an entirely different appearance from its fellows. It is the description of that very interesting specimen I am going to give, leaving the rest of that generation (F_1), as well as the next one (F_2), to a further study.

This exceptional hybrid attained the state of full development in which it is seen on the photograph, in the first part of September, 1923, and was then nearly 60 inches high, which means that it grew twice as tall as its Brussel sprouts parent. Its most interesting peculiarity was that it grew five large cabbage heads at the height of about 28 inches on the stem, instead of the ordinary, numerous, small out-growings of the Brussel sprouts. These heads, however, did not seem to make any effort at rolling up their leaves into a hard cabbage, which is so characteristic for the normal plant. The leaves hung rather loose. They varied greatly in dimensions. The largest head reached by September a size of 12 inches of diameter, (the side sprouts of the Brussel did not surpass 1½ inches). The others were smaller. The form of the leaves was exactly that of the paternal plant. The length of the bottom leaf of the biggest head was about 12 inches—the width (in the widest place) about 8½ inches—i. e., more or less the size of the ordinary cabbage leaf.

The top of the stem presented a very curious aspect: whilst the stem of the Brussel sprouts ends in a small and loose head, our specimen showed only a prolongation of the stem, with but a few upper leaves on it. On the top part of the plant the inflorescence appeared in late autumn; after the middle of October a few flowers appeared, but the plant was not able to produce any ripe seeds.

With the coming on of sharper frost (on account of a lack of suitable facilities, it was impossible to keep the plant through the winter), further growth stopped and our plant slowly began to die.

It will be seen from the proceeding

morphological description that our hybrid presents an utterly new form, by no means like either of its parents, or intermediate between them. It is a rather striking fact, that a similar form never appeared, either in the second generation (F_2), nor in any other similar cross, although I studied a considerable number of hybrids (about 600 specimens). Neither did I find any description of a similar plant in the literature.

We can easily assume, therefore, that the mentioned genetic combination takes place but very seldom. Perhaps this fact can be explained, by the possibility of the existence, as far as cabbage is concerned, of certain multiformed races, and our Brussel sprouts has been crossed with one of them.

I do not wish, however, to carry on any further reflection on what caused the peculiar form of our hybrid to appear. I desire only to confirm its existence, and to give a description of it. As the genetic research of the genus Brassica is being actively pursued it will eventually explain, let us hope, the apparition of such very curious phenomena of Nature.

Cultivated Trees and Shrubs of North America

MANUAL OF CULTIVATED TREES AND SHRUBS, by ALFRED REHDER, of the Arnold Arboretum, Harvard University. Pp. 930, price $10.50. Macmillan Co., New York, 1927.

A systematic and descriptive enumeration of the cultivated trees and shrubs hardy in North America, but not including those of the subtropical and warmer temperate regions. This manual will serve as a supplement to manuals of the spontaneous flora and will be of greatest interest to horticulturists, nurserymen, students, and teachers, and to all interested in plants for the ornamentation of home grounds. About 3,600 species, 2,500 varieties and 500 hybrids are included, most of which are of plants of the northern hemisphere. An especially valuable addition to the usual manual is a map of North America showing eight climatic zones. Under the descriptions of species in the text are given the zones in which each is hardy.

An an example of the contents, the cultivated forms of 48 genera of Rosaceae fill 152 pages, including 49 species and hybrids of spireas, 29 of cotoneasters, 42 of hawthorns, 21 of mountain ash, 25 of malus, 15 of pyrus, 51 of brambles, 72 of roses, and 77 of prunus.

In an examination of the classification and description of the 51 forms of brambles there are found citations of many of the principal works on this group. An excellent key is given. Many important horticultural characteristics are included in the descriptions making the material especially useful.

The use of independent judgment by the author contributes greatly to the value of contents. His connection with the institution which has introduced so many cultivated trees and shrubs from foreign countries in recent years has given the author a unique opportunity to produce this authoritative work. It is published by the same company that recently published the only other book of its kind. Bailey's *Manual of Cultivated Plants.* *George M. Darrow.*

PARACELSUS VINDICATED

Bacchus ever fair and young.

DRYDEN

"EAT, drink and be merry" with the prospect of death on the morrow was the ideal philosophy of life so wisely expressed by the author of Ecclesiastes about 500 B.C. Two thousand years elapsed before an attempt was made to alter this holy trinity of happy existence. Then the Puritans eliminated the merry, leaving eating and drinking. About this time Paracelsus, like many better men before and since, searched hopefully for the elixir of immortality. For him the quest ended with alcohol and he died a discredited drunkard; his life, according to the godly, having been shortened by assiduous devotion to this beguiling liquid. Pilloried by the poets as a pitiful example of scientific ineptitude, four centuries' accumulation of righteous ridicule have obscured his claims for the immortal properties of alcohol. After these many years, modern biometry rescues his reputation from slumbering disgrace and accords him a partial vindication.

As recompense for the loss of merriment, the new world increased its consumption of food and especially drink; literally drowning its sorrows in alcohol. In this manner it struggled along for another three hundred years; by which time the meddling Methodists awoke to the fact that the puritanical censorship of merriment had not produced the promised millennium of godliness and immortality. Clearly something was wrong and it didn't take the modern clericals two thousand years to find the defect! Drinking was prejudged the chief cause of human imperfection; high pressure preaching was applied, and prohibition resulted.

Eating and Making Merry

Modern philosophy, then is legally reduced to eating and, presumably, thereby, living, but it has not proved an easy matter to convince the great mass of people they can live on bread alone. Apparently something is lacking. Efforts have been made to revive mirth, but very curiously "eat and make merry" seems a combination that can be achieved only by the alchemy of that sublime catalyst—alcohol.

As a result, this country is in the throes of as bitter an alcoholic quarrel as ever raged on the sawdust floors of the humblest barroom. Everyone nowadays is militantly interested in alcohol, either pro or con; the subject has dominated our politics until it seems certain the next presidential campaign will be concerned more with liquor than with liquidation.

Under these circumstances everyone should be as fully informed as possible on all phases of the alcohol problem. To the biological aspect of this problem, Doctor Pearl, with his customary timeliness and refreshingly unorthodox point of view, contributes "Alcohol and Longevity."*

The book contains, in addition to the subject matter, life tables of several sorts of drinkers, an excellent index and a bibliography of 269 titles. The latter is stated to be but a small sample of the literature on this subject and promise is made for the publication of a complete bibliography. The Volsto-Wheelerians, baffled by the soundness of the exposition, doubtless will sneer knowingly at this book, dedicated to a night club; and well they may, if one may believe reports of these roistering robust scofflaws.

Following a careful analysis of the effects of alcohol on domestic fowls, Doctor Pearl was led to investigate

*PEARL, RAYMOND. Alcohol and Longevity, 273 pages. Alfred A. Knopf, New York. 1926. Price $3.00.

the effects of this substance upon humans. His interest was stimulated by an appreciation of the many similarities in fowls and humans; since alcohol had proved beneficial to the former, it seemed reasonable—all propaganda to the contrary—to expect that humans would show no ill effects from this substance.

Ecclesiastes Revised

A careful study of some five thousand Baltimoreans showed this to be true. Moderate but steady drinkers live at least as long as total abstainers, though chronic sots may anticipate a definite shortening of life. Thus the philosophy of Ecclesiastes returns, modified to read, "Eat, drink and make merry, for thus you will be favored by a long life."

It is realized that this result will come as no surprise in certain of the arid regions, since Marylanders have a reputation for thriving in a wet environment. Nevertheless there can be no just complaint that the data were biased, since the study is based upon life histories collected for the purpose of determining what factors are conducive to tuberculosis.

The records were carefully chosen to insure elimination of the defects common in much statistical material. The population considered was racially homogeneous and the families were of the same economic level. The results, therefore, can not be discredited on the ground of poor judgment in choice of material. No doubt will remain in the mind of the reader that for the 2,000 Baltimoreans drinking steadily but not excessively in the pre-Volsteadian era, life lasted fully as long if not longer than for their 2,300 abstaining neighbors. That it was also a *fuller* life can not be gainsaid, but Doctor Pearl carefully refrains from pointing the moral of his conclusions. He is far too wise to assume that stimulated prejudice can be overcome by the mere presentation of facts. Further, he expressly warns that what is clearly true for a large statistical group may not be true at all for the individual. The only advice for the individual is for him to determine by "exact experimentation" his own capacity. The reviewer sadly records that Doctor Pearl makes no suggestions as to how the aspiring candidate is to acquire this knolewdge, in the absence of the chief reagent. One can only regret that Baltimoreans generally are prone to overlook the very real deficiency of good liquors in many of the less liberal localities.

Of course results so contrary to Methodistic principles will not pass without attempts to discredit them. The most common form of criticism will be to declaim long and loudly that had the drinkers only abstained, they would have lived even longer. In this particular problem the contention will seem quite plausible, since critics may argue from their own experience that abstainers, as a class, are weaklings who realize their defects and abjure alcohol. Drinkers, on the other hand, appreciate their powerful constitutions and, therefore, do not hesitate to embrace the joys of the bottle.

Pleasantly as most of us would view this explanation Doctor Pearl is not convinced; and though his ardor for facts results in our losing the gratification of having abstainers self-branded as defectives, we gain the satisfaction of seeing this crafty criticism successfully controversed.

Wet and Dry Sibs

Knowing the point would certainly be raised, Doctor Pearl winnowed the records of his five thousand Baltimoreans to discover abstainers whose brothers drank. In this manner non-drinking controls, closely related to the drinkers, were obtained, thus paralleling, as nearly as possible, the method customarily used in experimentation on the lesser beasts. This procedure, however, departs from that followed in controlled experiments since here the individual brothers, of

their own volition, made the choice, as to whether they would drink or abstain, instead of being selected for their fate by the investigator. The latter method, of course, is preferable—from an experimental point of view—but in the very nature of humans is impossible, as the prohibitionists are slowly discovering.

As the result of a careful search of his 5,000 records, Doctor Pearl found 94 total abstainers with brothers who drank steadily though moderately. Without digressing to discuss what a family affair drinking seems to be, it is obvious that these brothers comprise a body of data more homogeneous with respect to constitutional vigor than drinkers and abstainers chosen without respect to parentage. Now, clearly, if drinking shortens life, the 94 abstainers should live longer than their more convivial brothers. Analysis shows that had the bonvivants foregone the golden years of drinking they would have lived not quite so long as they did! The result inclines one to accept literally the waggish aphorism, that life for abstainers is not actually longer but only seems so.

I would not have the reader gain the impression that Doctor Pearl has treated the liquor problem lightly. His book describes and reports upon a brilliantly conceived and carefully conducted analysis of a study seriously undertaken. That such a study should lead to certain reflections on our present political aridity is no more than could be expected.

The author undertook the investigation wholly unprejudiced, except insofar as his experiments with chickens had aroused his incredulity of the claims of the anti-salooners. He has been at pains to state clearly the mental attitude in which he approached this highly controversial problem; a precaution that may lead the reader to conclude "he protests too much" but no one will be disposed to deny that the data have been treated adequately and honestly.

Choosing Liquor-Proof Parents

Although many sincere people will feel that statistical studies of this nature can not contribute to the solution of the problem of drinking, the fact remains that it is only by such methods any knowledge, whatever, can be gained of human reactions to the alcohol habit. Doctor Pearl has stated repeatedly, elsewhere, his preference for experimentation, as contrasted with biometrical analyses of family histories, but obviously the alcohol problem does not lend itself readily to experimental methods.

The reader is at liberty to disagree with the author's classification of drinkers, choice of race, locality, or economic level, but he can not avoid concluding with Doctor Pearl that the group classed as "steady moderates" did not shorten their lives by drinking.

Having seen that steady but moderate drinking is conducive to normal life, one feels with Doctor Pearl that the question has been effectively summarized, from the viewpoint of individual practice, by Henry Jones (in The English Review for December, 1924):

> With respect to alcoholic disease, as with other diseases, the chief thing is to get oneself born with an immunity to it. I took this precaution against alcohol, and thereby have been able to enjoy a bottle of wine a day for the last forty years, without ever getting drunk, without ever approaching drunkenness, without ever wishing to take more than was good for me. Such are the advantages of belonging to God's elect, as the apostle affectionately calls us. . . . As one born with a capacity for taking a moderate, harmless quantity of wine, I strenuously protest against being degraded into equality with C_3 degenerates to whom alcohol is poison. Of all the devastating applications of the false and abominable doctrines of equality, this is one of the most intolerable. Why should a poor but healthy laboring man, whose rich brawny thews and vigorous stomach righteously demand a draught of refreshing ale, be condemned to meager and

gloomy equality with the rich valetudinarian, to whose queasy digestion a mere sip of alcohol is veritable poison? Away with this damnable doctrine of equality where it tells so hardly upon the working man!

JAMES H. KEMPTON.

A Call for Creative Biology

. . . Just seven years have slipped away since the Peace Treaty was signed, and we do not yet know whether our ship is slowly sinking or will right herself. Our cousins, over yonder, say we are "down and out." They relish exaggeration; yet who can study the events of 1926 and remain blind to the threat that Britain's days as the workshop of the world are numbered? The coal and iron and engineering genius, which together with our coast-line placed us far in the van of industrial development, can keep us there no longer, but our industrial population remains. Trained intellect alone can enable us to hold our own until the transformation of our social organization shall have been accomplished without catastrophe. Trained intellect—not only, nor even chiefly, trained in technical science. It is true that science furnishes the key to Nature's storehouse of power, that the trained intellect has made man a creator, but of even greater importance is the use he makes of the power and the kind of life he creates. Science is determining the material conditions; the new humanism must rise to the occasion and teach us how to live. Creative thought is what the world is needing in all departments of life; it will express itself in literature and other arts, and it will issue in new hope and energy in all ranks of society. The destiny of Great Britain, and even its immediate future, hangs upon the success we can achieve in leading the right men to devote their lives to science, in supplying the needs for their work, and in permeating the nation with a sense of responsibility that the gifts of science shall not be misused.

Great Britain has indeed been exporting much of its "invisible item" for many years to India and other parts of the globe, carrying the white man's burden. There are obvious signs that this export, like others, will diminish in the near future—no other country has suffered such a drain—and with this leak stopped, the home level may be expected to rise.

No one can doubt that the talent is there. Does any one claim that we make the most of it? The practical problem is beset with difficulties, complexities, incompatibilities. There is no single simple solution possessing all the virtues and omitting none! and time is precious. Ought boys to leave school and approach their university studies fresher in mind? Is too early specialization in schools a cause of sterility later; and when is *too* early?

. . . Unfortunately, at present the effect of the university on some of the most promising boys is as though the coils were wrongly connected; we get not amplification but damping. Many a teacher, not alone the science master, knowing the keenness and capacity of his most brilliant scholars, has felt sick at heart as he noted the effect upon these boys of the enforced repetition of work done years before at school.

From "Schools and Universities," editorial in *Nature*, January 22, 1927, pp. 109-110.

DETERMINATE GROWTH IN THE TOMATO

A. F. YEAGER
North Dakota Experiment Station

TIP OF SELF-PRUNING TOMATO

Figure 10

This is a late variety, but one showing a determinate type of growth, producing blossoms at the tips of the branches.

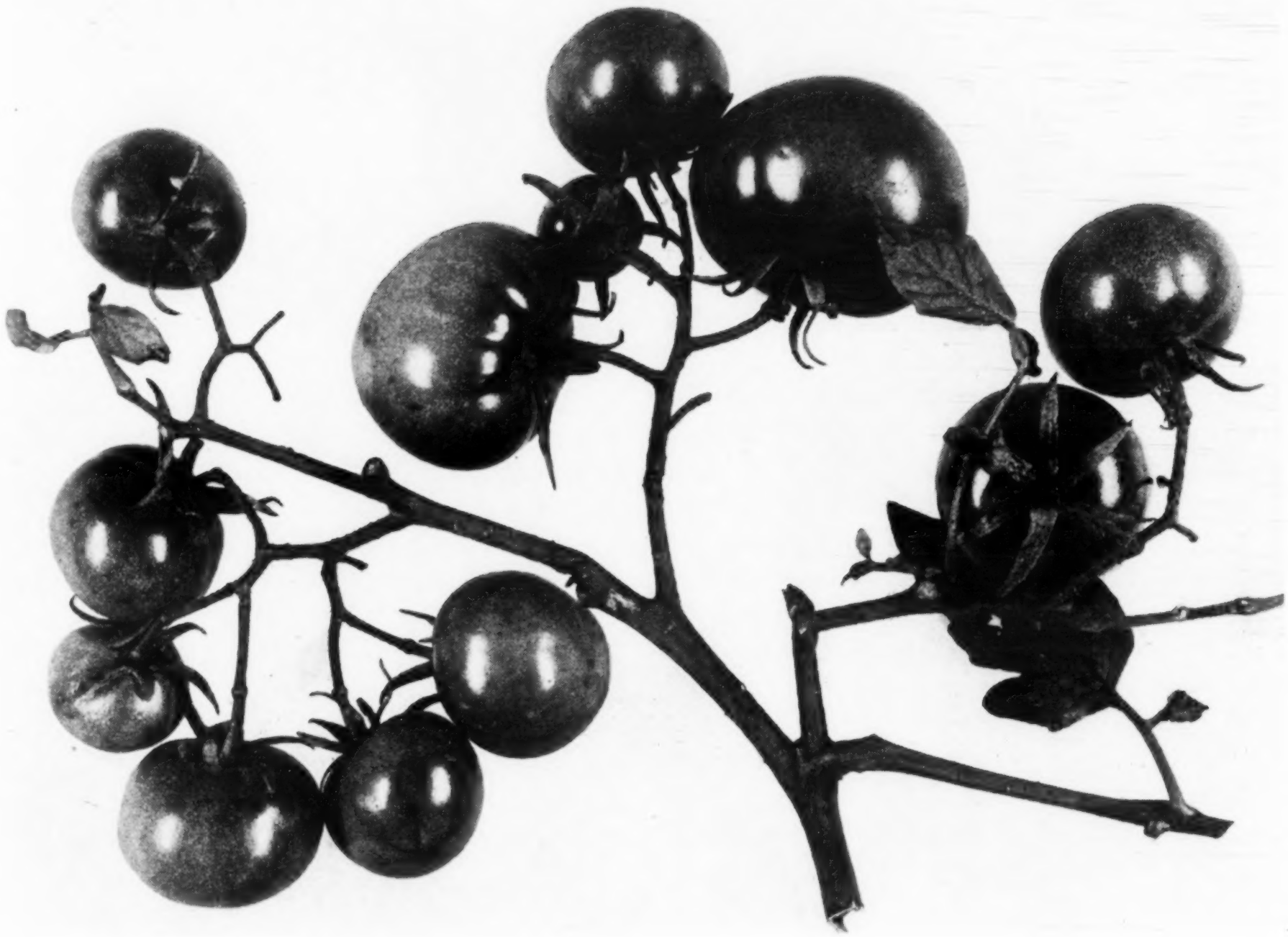
THE tomato is normally a perennial plant as shown by its indeterminate habit of growth. Under field conditions in the north where seasons are short, even with the earliest varieties, vines seldom ripen a very large percentage of their crop and some growers resort to the strategy of pruning off the end of the vine when it has set several clusters in order to prevent the waste of energy arising from the setting of late clusters of fruit which cannot ripen.

At the North Dakota Experiment Station in our variety trials several years ago we were especially interested in a variety of tomato from the Burpee Seed Company, called Self-Pruning, which had the remarkable characteristic of determinate growth, producing blossom clusters at the tips of the branches. Unfortunately, the

USUAL HABIT OF GROWTH OF TOMATO

Figure 11

Tip of Red River Tomato, an extra early variety showing the usual indeterminate type of growth.



EARLY SELF-PRUNING SEGREGATE

Figure 12

Tip of a selected F_2 segregate photographed at the same time as Figures 1 and 2, showing combined earliness of Red River and the determinate type of growth of Self-Pruning.

variety, while of high quality was a late one, hence of little value in North Dakota. A cross was made between it and Red River, an extra early red variety of our own breeding. In the F_2 generation grown in 1926 a number of segregates apparently combining the earliness of Red River with the determinate growth characteristic of the other were secured. Such plants were less than three feet across and ripened practically their whole crop, while all other plants in our trials were six feet or more in diameter, and were covered with green fruit at frost time. The determinate habit appears to be a simple Mendellian recessive from the data we now have. Selections from this crossed population should give us a valuable new race of early tomatoes.

THE OCCURRENCE OF SEMI-STERILITY IN MAIZE*

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DURING the course of certain studies on the waxy character in maize, which may be identified in the male gametophyte, the writer has had occasion to examine microscopically the pollen of several scores of pedigreed plants. Among thrifty individuals one usually finds about 90 to 98 per cent of the pollen grains well formed and apparently capable of further development; the remainder are deficient in size or content and are obviously non-functional. It is to be expected that some microspores will be handicapped in their growth on account of unfavorable conditions in their environment arising through variations in nutritional conditions within the pollen sac. The small numbers of defective pollen grains commonly observed are probably largely due to circumstances of this kind. A case has been found, however, in which the proportion of aborted grains approximates 50 per cent and the condition recurs among the offspring of defective pollen producers. Evidently this phenomenon is genetic.

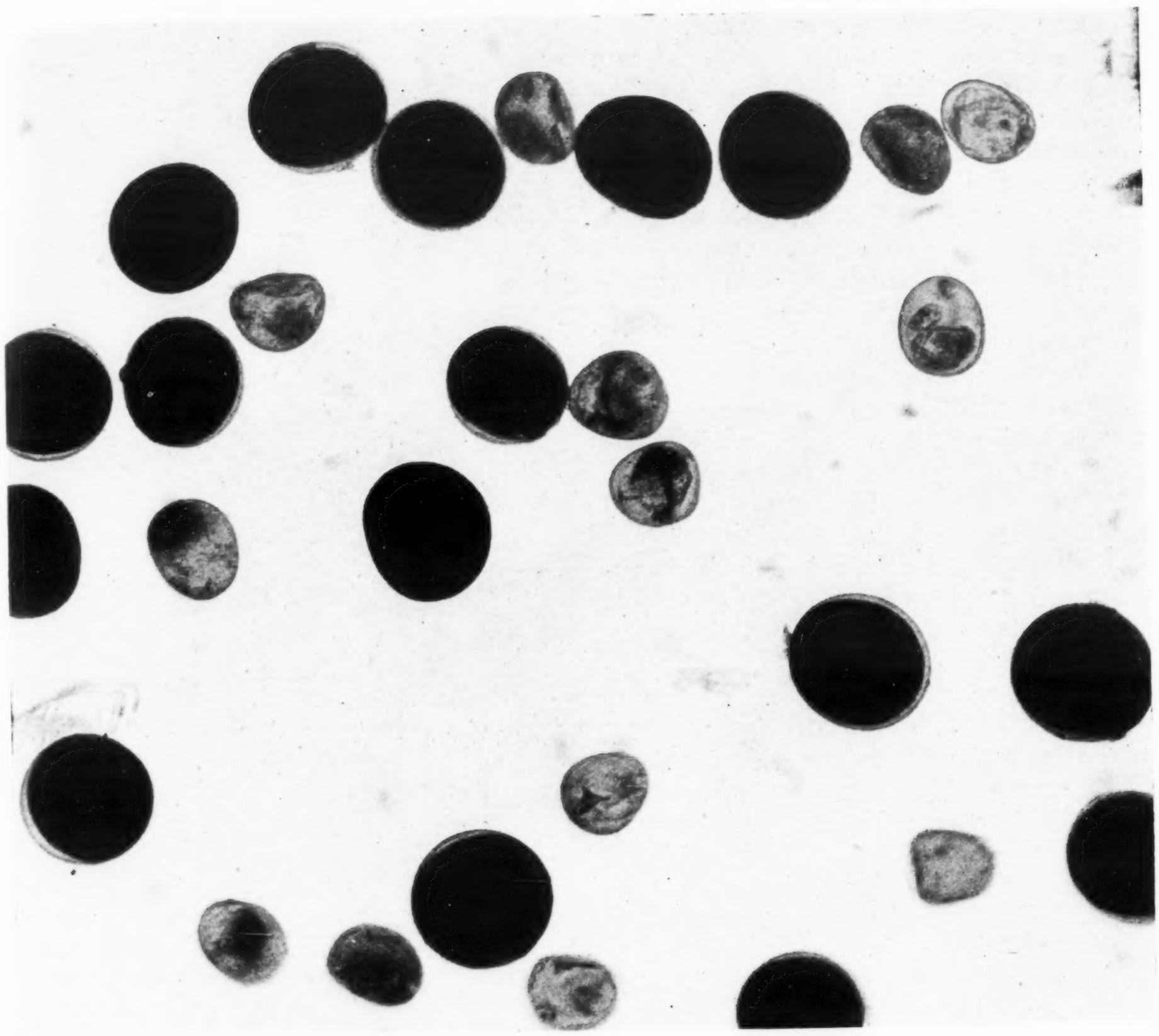
In 1925 two progenies, designated R22 and R22a, were grown from the non-sugary and the sugary seeds, respectively, on an ear produced by selfing a plant whose known factorial composition was *Su su Wx wx*, that is, heterozygous for the sugary and the waxy genes. The pollen of 62 plants in R22 was examined; in 6 of these individuals about one-half the grains were empty while the remaining plants produced the usual proportion of sound pollen. In progeny R22a observations were made on 24 plants; in this group 2 individuals showed about 50 per cent aborted pollen. Eight plants in 86 or about 9 per cent, therefore, exhibited what we may conveniently call the semi-sterile condition.

Five of the segregating plants whose pollen was counted were heterozygous for the waxy character. The relative proportions of the three types of grains produced by these individuals are given in Table I. It will be noted that about one-half the pollen grains in each case are aborted and that the sound ones are about equally distributed between the waxy and non-waxy classes. The normal waxy ratio, therefore, is not disturbed. One plant not segregating for the waxy character showed 414 sound and 458 aborted grains.

Pollen from a semi-sterile plant is shown in Figure 13. The defective grains possess some cytoplasm but are devoid of starch and fat. If the aborted pollen grains are stained with safranin a nucleus can usually be seen; frequently two nuclei are present. The intine and the exine with its germ pore are clearly differentiated.

The matings involving semi-sterile plants made in 1925 are shown in the second and third columns of Table II. It was not noted at the time the resulting ears were harvested or when the seed was taken for planting the following spring that several of the ears bore only one-half the possible number of grains. The partially filled character of certain ears obtained from the 1926 representatives of these stocks led to observation, however, that 50 per cent of the ovules on segregating individuals also abort. Fortunately, remnants of 6 of the parent ears were still available; on examination of these it was found that three, resulting from the use of semi-sterile individuals as pistillate parents, showed one-half the ovules unde-

*Papers from the Department of Genetics, Agricultural Experiment Station, University of Wisconsin, No. 70. Published with the approval of the Director of the Station.



DEFECTIVE POLLEN GRAINS

Figure 13

Pollen from a semi-sterile plant mounted in a weak solution of iodine. Fifty per cent of the grains are aborted.

veloped, whereas the remaining three, borne on normal sibs, contained the full number of kernels. The lethal condition, therefore, affects both pollen and ovules, eliminating half of these on segregating plants. Ears produced on semi-sterile individuals bear only 50 per cent of the normal number of seeds irrespective of the source of the pollen used, since the lethal operates prior to fertilization.

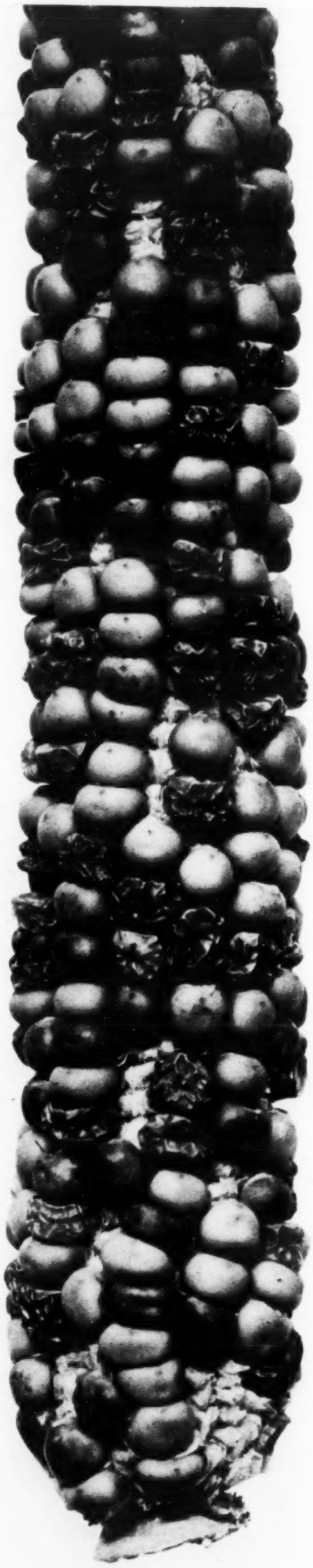
In Table III the distribution of normal and aborted seeds on ears obtained in progeny R155 in 1926 are shown. The remnants of the ovaries containing aborted ovules are small hollow structures, papery in texture and often completely enclosed within the glumes; they might readily be overlooked on ears in which the normal grains are large in size and flattened, but can be dissected out on systematic examination of the ear. The partially filled condition characteristic of the ears produced by semi-sterile individuals is illustrated in Figure 14.

In columns 4 and 5 of Table II the distributions of normal and semi-

sterile offspring following the various matings made in 1925 are given.

The breeding relationships shown may be explained on the assumption that two allelomorphic pairs of genes are involved *A, a* and *B, b*. This hypothesis may be outlined as follows. There are two classes of normal individuals which we may designate *AAbb* and *aaBB*. Each of these types when self-pollinated or crossed with its like gives only normal offspring; when the two types of normals are mated with each other the progeny are all semi-sterile. There is a single semi-sterile genotype, the factorial composition of which is *AaBb*. It is assumed that *AB* and *ab* spores are abortive while the *aB* and *Ab* classes are functional. This accounts for the production of only 50 per cent normal microspores and embryo sacs by semi-sterile plants. If self-pollinated or crossed with a normal plant *AaBb* should produce normal and semi-sterile offspring in equal numbers. The genotypes *AABB, AaBB, AABb, Aabb, aaBb* and *aabb* are, presumably, non-existent since *AB* and *ab* gametes involved in their formation are not viable. This hypothesis is very similar to that Belling[1] offers to account for the inheritance of semi-sterility in the Velvet bean, Stizolobium.

While the breeding facts, so far as they go, are in accord with this hypothesis it meets a serious difficulty when we seek to account for the origin of the semi-sterile condition. According to our scheme *AAbb* and *aaBB* are the normal genotypes and the spores they produce, *Ab* and *aB*, the only functional classes. How did *AAbb* and *aaBB* arise in the first place? We cannot suppose they arose from *AABB, AaBB, AABb Aabb, aaBb* or *aabb* individuals by gene mutations since, by definition,



HALF THE OVULES ABORTIVE

Figure 14

An ear resulting from pollination of a semi-sterile plant. Gaps occasioned by the abortion of 50 per cent of the ovules can be clearly made out. Incidentally this ear is segregating for sugary and color.

these latter genotypes cannot occur. If *AAbb* gave rise to *aaBB* or, *vice versa*, *aaBB* to *AAbb*, it is necessary to assume simultaneous mutations in two genes, a highly improbable event. Indeed, it is unlikely that gene mutations are involved at all.

The facts suggest that a change involving two pairs of chromosomes has occurred giving rise to a new spatial arrangement of certain hereditary elements. In reporting what appear to be parallel cases in Datura, Blakeslee and Cartledge[2] note this possibility. One might suppose that a portion of one chromosome has become attached to a member of a non-homologous pair and that all spores receiving the "disjoined" section in duplicate or lacking it altogether are abortive. It might be equally well assumed that two entire non-homologous chromosomes have become attached and assort together.

It would appear that the original change took place in the immediate parent of the progenies in which the semi-sterile condition was first observed. Since about 9 per cent of the offspring were affected the event apparently occurred in a vegetative cell whose descendants comprised only a portion of the tissue from which macrospores or microspores, or possibly both, were formed.

Literature Cited

1. Belling, John. The mode of inheritance of semi-sterility in the offspring of certain hybrid plants. *Zeit. f. ind. Abstamm. u. Vererb.* 12:303-342. 17 figs. 1914.

2. Blakeslee, A. F. and Cartledge, J. L. Pollen abortion in hybrids between selected biotypes in Datura. *Anat. Rec.* 34:174-175. Abstr. 1926.

TABLE I - THE OBSERVED RATIOS OF NON-WAXY, WAXY AND ABORTED POLLEN GRAINS IN INDIVIDUAL PLANTS

Plant No.	Number of pollen grains		
	Non-waxy	Waxy	Aborted*
R22 - 3	178	201	353
-11	133	138	298
-16	122	115	284
R22a- 7	116	112	255
Totals	549	566	1190
Normal: Aborted	1115		1190

*Due to the tendency of the defective pollen grains, when mounted in a watery solution on a slide, to move toward the periphery of the drop there is probably a small systematic error in these counts, the aborted class being too low. Since from 2-10 per cent of the grains in normal plants are defective as a result, presumably, of non-genetic factors, we should expect more than 50 per cent of the pollen in semi-sterile individuals to be aborted.

Tables II and III on next page

TABLE II - SOME RESULTS ON THE INHERITANCE OF SEMI-STERILITY

Progeny Number	Parents	Type of Mating	Distribution of Offspring	
			Normal	Semi-sterile
R 152	R22a-21 x R22 -32	semi-sterile ♀ x normal ♂	23	18
R 153	R22 -11 x S35 -35	semi-sterile ♀ x normal ♂	6	12
R 155	R22 -16 x A6b - 5	semi-sterile ♀ x normal ♂	5	10
R 154	R22 -32 x R22a-21	normal ♀ x semi-sterile ♂	16	24
R 156	R21a-21 x R22 -35	normal ♀ x semi-sterile ♂	30	47
R 157*	R22 -33 selfed	semi-sterile selfed	52	0
R 158	R22 - 3 selfed	semi-sterile selfed	33	41
R 159	R22a-21 x R22a- 7	semi-sterile ♀ x semi-sterile ♂	18	24
R 160	R22a-21 x R22 -16	semi-sterile ♀ x semi-sterile ♂	11	22

*Progeny R157 grown from the seeds on a self-pollinated ear from plant R22-23 is under suspicion. According to the record made in the field at flowering time, on the basis of the character of pollen produced, R22-23 was a semi-sterile individual. If the plant in question were really semi-sterile the ear borne upon it should have produced only one-half the normal number of seeds (see text). While the ear obtained is not now at hand the records show that it bore 398 normal seeds. This large number of seeds makes it unlikely that the ear came from a semi-sterile plant. Ten ears borne on *normal* plants in progenies R22 and R22a carried 373.5 seeds, on the average; the extreme values were 306 and 460. If R22-33 were semi-sterile and consequently producing but half the usual number of seeds we should be forced to conclude that the total number of ovules formed was 398×2 or 796; this number is far in excess of the highest value for ears from normal plants in the same progeny. It would appear that an error was made in the field in marking R22-33 as a semi-sterile plant. The results obtained with it are not considered further in the present discussion.

TABLE III- DISTRIBUTION OF NORMAL AND ABORTED SEEDS OBTAINED ON SELF-POLLINATING SEMI-STERILE PLANTS

Pedigree No.	Number of Seeds	
	Normal	Aborted*
R155b - 4	258	239
- 5	305	397
R155c - 1	378	340
- 2	299	317
- 5	280	253
Totals	1520	1546

*One might expect the frequency of this class, on the average, to exceed that of the normal since such ovules as remain undeveloped for extraneous reasons are, perforce, included in the counts.

HEALTH PROGRESS AND RACE PROGRESS*

Are They Incompatible?

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ALL organisms are forced to defend themselves in manifold ways against other organisms that seek to destroy them; against bears, beetles, bacteria. All organisms must protect themselves against the injurious forces of nature; against heat and cold, and wind and wet; against starvation and repletion; against unfit food and drink; against bumps, bruises and broken bones; against plagues and poisons. From Amoeba through the oyster up to man, life is a struggle for existence; this is a mere commonplace. If any organism ceased this struggle, ceased to select its environment, ceased to protect itself, its kind would become extinct in a generation.

So it is with man; so it is with the bird, the fish, the worm, the protozoan, the plant. But are there limitations that must be placed on this protective struggle? Are there paradoxical situations at which success in the struggle makes for degeneration and destruction, instead of for the survival and prosperity which are its direct objective? Are there methods of protection, of defense, which organisms must not employ; methods that overshoot themselves and fall on the other side? May the struggle for existence be waged too efficiently, so that its indirect results turn against and destroy those directly reached?

Such are the general biological questions that underlie the criticisms, the forebodings of evil, directed upon public health work. Are there junctures at which man must adopt, in opposition to his practice for the last 20,000,000 years, in opposition to his most masterful and clamorous impulses, the maxims, resist not evil, resist not death? How shall we know these junctures? What is their nature? And specifically, does the activity of the social worker, the public health officer, fall in this class? Is there something in their methods which indirectly defeats the ends at which they aim; something that produces deterioration and extinction in place of health, survival, progress?

The piercing point to these questions comes from modern work in genetics. That has indeed revealed to us junctures at which indiscriminating promotion of survival and propagation may tend toward degeneration. That has produced for us, in the Drosophilas of Morgan's laboratory, the exemplar of a population composed of the congenitally defective; the halt, the blind, the weak, the variously deformed and degenerate; a population whose special character results from the types which have, and have not, been allowed to survive and propagate. Just what is it that underlies such results?

Defective Genes

Experimental biology has shown that at its beginning the organism is a complex thing, containing a great number of separable substances—what we call the genes. By the interaction of these thousand substances—with each other, with the cytoplasm, with materials brought in from outside, with the forces of the environment—development takes place, the individual is produced with all his later characteristics. In early stages of development, the interactions of the genes produce new chemicals, the hormones or endocrine secretions; these again react with other

*Address for Twenty-third Annual Meeting of the National Tuberculosis Assiciation at Indianapolis, May 24, 1927.

products, until there result, in a series of successive steps, all that we find in the body; the sex hormones, the thyroid hormone, the hypophysical hormone; epinephrin, insulin, the digestive and other secretions; the blood, the tissues, the organs, the mature individual.

But not all sets of genes are alike. Some among the genes may be defective; such sets yield defective products. Hormones may be produced that are deficient in quality or quantity, or both; this results in further defects. If the thyroid secretion is defective, either from poor genes or poor nutrition, the individual fails to develop normally; it becomes that pitiful half-formed thing, a cretin, an idiot. If insulin is not properly formed diabetes results. If the sex hormones are not normal, intersexuality or other discordant condition follows. These are types of the results which follow from the operation of defective genes, or from defective interaction of the genes.

But chemical therapeutics discovers that disorders due to defectve genes can be remedied, if we know the means, just as other chemical processes may be influenced. The consequences of a defective thyroid secretion are remedied by introducing the thyroid hormone with the food; the pitiful cretin becomes a normal human being. Lack of insulin is similarly remedied, by introduction of insulin from outside. The necessary chemicals can even be synthesized, made artificially, as recent revolutionary researches show. In principle, it is clear that defects in the store of chemicals given us by heredity may be supplied by other means; that undesirable things in the store of genes may be cancelled or corrected; that reactions among them which take an undesirable turn may be altered, set right. All these things are seen to be mere matters of technique; one needs but to *know how*. The great advances already made in this direction have come in the last ten years. How far will they have gone in 100 years? In 1000 years?

Wonderful possibilities are opened up by this work. Unfortunate human beings that must have suffered in misery, a burden to themselves and others, are made normal, useful, happy.

But consider now the farther results of an enormous future development of synthetic chemistry; of chemical therapeutics. Defects in genes become as open to remedy as defects in nutrition. A defective thyroid product is replaced by manufactured thyroxin; the individual is restored to normality. But his genes are not changed; they remain defective; they are transmitted to his descendants. His descendants too must be treated with thyroxin. The genes of another individual are defective for the secretions of the hypophysis; of another for the supra-renal secretion; of another for the reproductive hormone; of another for insulin. Chemotherapy remedies all these defects—for these individuals. But their descendants, receiving the defective genes, must likewise come under the treatment of the chemist. In time the race thus accumulates a great stock of these defective genes. Every individual that receives them must be treated with one or more of the substitutes for the normal products of the genes. Each must carry with him an arsenal of hypodermic syringes, of vials, of capsules, of tablets. Each must remain within the radius of transportation of the synthetic chemical laboratory on which he depends.

This picture is not an attractive one. Far better is the later condition of the race in which, through lack of skill in synthetic chemistry, defective genes have been cancelled as they arise; so that each individual bears within himself, in his stock of genes, an automatic factory for the necessary chemicals. That must be our aim; our slogan for future generations must be: Every man his own hormone factory!

Survival and Propagation

How is that end to be attained? Is there no recourse but to strike at synthetic chemistry? Must the unhappy chemist be proscribed, prose-

cuted, imprisoned, hanged; his books burned, his teaching forbidden, his methods of work prohibited? Must the cretin drag out his life a helpless idiot, the diabetic suffer unrelieved, until their own defects close their lives in misery and so cancel their stock of genes? Are these the methods that must characterize our policy toward defects in the genes?

It certainly behooves us as rational beings to examine such a situation with care; to search whether there is not, peradventure, another way of meeting it. And when we do this, we find these proposed measures to be totally and preposterously unnecessary, uncalled for, absurd; nay more, ineffectual. There *is* another recourse, a similar one, a more effective one; an infinitely preferable one.

The mere survival of a genetically defective individual, nay, his enjoyment of a full, a useful, a happy, a long life, does nothing to increase the degeneracy of later generations—provided he does not propagate. Not survival alone, but also propagation, is required for the perpetuation of defective genes. Without propagation, survival is harmless, so far as racial deterioration is concerned. Can there be any question as to which shall be the point of attack? Surely we write ourselves down as asses, as doubly and triply stupid, irrational, perverse, if in order to prevent the perpetuation and multiplication of certain genes, we can think of no method better than to stop scientific investigation, to stop humane practices, to force our fellow beings to live and die in remediable misery. The lives of persons bearing defective genes may be made as satisfactory, as complete, as the most advanced methods can make them, without the smallest harm to the race—but they must not propagate.

Not the wasting away and death of the bearer of defective genes, therefore, but the prevention of his propagation, is our remedy. The method of allowing the individual's own defects to destroy him is not only hideously repulsive to our instincts, but a knowledge of genetics shows it to be ineffectual; it does not get rid of the defective genes. Most gene defects are recessive; they are, therefore, carried by ten times as many healthy individuals, not showing the defects, as by individuals in which the defects are manifest. The children of such healthy individuals receive defective genes, as do the children of defective individuals. Congenital feeblemindedness due to a single gene defect presents perhaps the most pronounced and the very simplest case of gene defect that has to be met. Yet East[1] and Punnett[2] have shown that to merely cancel the deficient individuals themselves — those actually feebleminded—makes almost no progress toward getting rid of feeblemindedness for later generations. As East pointed out, any really effective action in this direction requires that we learn in some way to distinguish the tenfold larger number of normal individuals that bear the defective genes; and that we prevent their propagation. To merely cut out the defective individuals themselves; particularly to do that only weakly, haltingly, ineffectually (allowing them time perhaps to propagate before death overtakes them)—as would result from withdrawal of public health measures—*that* will not touch the root of the trouble.

The *only* remedy is stop the propagation of the bearers of defective genes. The public health worker must take this fact seriously; a burden of responsibility is placed on him; he *must* become genetically minded, eugenically minded. If he promotes, in the congenitally defective, propagation as well as survival, his work does indeed tend toward a measure of racial degeneration. But it is the propagation, not the survival, that is the central point. So fast as we can discover individuals that bear seriously defective genes—whether themselves personally defective or not —so rapidly must those individuals be brought to cease propagation.

There are great difficulties, of course. The instincts connected with propagation are strong. But those instincts are

readily circumvented. They can be satisfied without the production of offspring. Thousands of individuals in every generation voluntarily relinquish the leaving of descendants. Far different is the case with any method that strikes at life itself, once that is in action. To life humanity clings with every trembling fibre of its being. The difficulties of ending the careers of defective genes by preventing propagation of their bearers are as nothing compared with the hopeless proposal to allow defective individuals to waste away and die unaided. Can anyone suppose that a race of beings so perversely stupid as to refuse to stop even the propagation of defective individuals can be persuaded to adopt the barbarous, needless and ineffectual plan of killing them by the slow, the cruel method of refusing them help in their distress?

Technically, a greater difficulty lies in the fact that the great majority of defective genes are stored in normal individuals; and that recognition of these storehouses is not yet possible. Before that can be done, genetics must advance far beyond its present point. For no scientific advance is there greater need. But any single case saved from propagation is a gain. A defective gene—such a thing as produces diabetes, cretinism, feeblemindedness—is a frightful thing; it is the embodiment, the material realization of a demon of evil; a living self-perpetuating creature, invisible, impalpable, that blasts the human being in bud or in leaf. Such a thing must be stopped wherever it is recognized. The prevention of propagation of even one congenitally defective individual puts a period to at least one line of operation of this devil. To fail to do at least so much would be a crime.

Public Health and Racial Health

But how far is there reason to hold that public health work is indeed preserving individuals with defective genes? There can be little doubt, from the general picture presented by genetic investigation, that diversities in the genes, in the original constitution, of different individuals, affect every characteristic, of whatever sort, without exception. There can be little doubt that, other things being equal, some genetic constitutions are more readily attacked by plague, by smallpox, by typhoid, by pneumonia, by tuberculosis, than are others. Certain constitutions yield more readily to extremes of temperature, to exposure to the elements, to unfit food. Certain combinations of genes are more likely to come off victorious in a struggle with a wild-cat; or to survive a bite from a rattlesnake. Under such emergencies, those genetic combinations which survive are more desirable. And removing any of these sources of danger—cutting off plague or pneumonia or wild-cats or rattlesnakes, or subjection to cold — does permit combinations of genes to survive and propagate that otherwise could not do so. Any radical change in the environment alters the incidence of selective elimination; consequently alters the characteristics of the population in later generations.

But for all such cases the essential question is this: If the environmental agent — whether disease, weather or wild beast—can be controlled, prevented from attacking man—are the individuals thereby saved undesirable, unfit, *in other respects,* to be citizens of the world? Are their genes radically defective, inevitably yielding deficient men and women, even though protected from environmental conditions that they are unable to resist? Or are they merely particular combinations in the great kaleidoscopic shuffling of genes as generations change; combinations that are fitted to one environment rather than another? No combination of genes yields human beings that flourish equally well in all environments. The victims of smallpox, yellow fever, hookworm, malaria, of sunstroke, frostbite, lions—are they individuals with such serious genetic defects as will make

them or their descendants obnoxious, degenerate, members of the community —even when those plagues have been banished by hygiene and invention?

Of course this is, for every separate case, a question of fact, to be determined by investigation. In some cases, as we have seen, it is now clear that the individuals saved do bear deficient genes; these are the cases for which the remedy is cessation of propagation. In certain other of the plagues of humanity the question is still open; such perhaps are tuberculosis and cancer. In certain strains of animals, marked susceptibility to cancer is due to a single gene defect; if such strains are to be found in man, their members must not propagate. But we must not fall into the fallacy that was characteristic of the beginnings of knowledge in genetics—the fallacy of holding that because in some cases cancer is dependent upon a serious gene defect—therefore it must be so dependent in all cases. Cancer may be induced in strains that are seemingly quite normal —though less readily induced than in those with defective genes.

With tuberculosis, so far as I can discover, the case for gene defects is not strong; but I must leave this question to those who are carrying on detailed investigations in this field.

But for most of the matters with which the public health worker deals, there appears to be no indication whatever that the individuals preserved are undesirable, or at a disadvantage, in a world in which the attacking agent has been controlled; no indication that defective genes are playing an important rôle. There is not ground for holding that all differences in genes, in man, imply defectiveness in one or the other. We cannot in man (as perhaps we can in Drosophila) set up for each particular gene one type as the only normal one, compared to which all others are defective. There are many types for each gene; some adapted to one method of life, some to another. There are millions of diverse combinations of these different types, some flourishing better under one set of conditions; others under another set of conditions; none of them require to be considered pathological.

Selective Elimination

Our question here merges into a general biological one. Must *any* protective or defensive action, any selective control of the environment, be held harmful to the race, as leading to degeneration, through the cessation of selective elimination?

Various dangers have been suggested. Increased propagation resulting from environmental control may result in a greater population than the environment can comfortably support. Here the remedy, if one is required, is again obviously to slow down the rate of reproduction, as most civilized communities are doing.

Again, full success in protection by one method makes it unnecessary to develop other methods. The oyster, protected by his thick shell, has not developed ingenuity, inventiveness, intellectual power. Coming in contact with another organism that has, it may go to the wall, as the oyster shows signs of becoming extinct in contact with man. This somewhat speculative difficulty suggests no practical measures for our own case.

More palpable is the following: Complete success in any one method of defense against a particular enemy makes other methods unnecessary; the organism is no longer selected with reference to those other methods, and may lose them. Completely destroy certain pathogenic bacteria, or develop external methods of protection against them; in consequence the internal protective action of the body fluids is no longer necessary; it might in the course of generations be lost. If by clothing, houses, fire, we keep our bodies at the optimum temperature, we may lose in later generations the power of resisting high and low temperatures.

The extent of the occurrence of this sort of action is rather speculative. But assuming that it occurs, the result in

the first instance is merely that the organism no longer retains the power of resisting an enemy that does not attack it; a harmless change.

If, however, by a change in conditions, as by a sudden overwhelming alteration in climate or an increase in the virulence of a bacterium, the methods of protection hitherto employed become ineffectual, then the organism might be driven back on its second defense; its internal power of resistance to infection, or to cold. If this has been lost, the organism might become extinct. Speculative ingenuity may suggest that this has been a cause of the extinction of some organisms that have disappeared.

But in view of the fact that control of the environment is the very fabric of life; that organisms cannot live without it; that they have been practicing it assiduously for a hundred million years, and that some of them are still flourishing, it appears idle to suggest that such control must be abandoned; it appears whimsical to look for imminent degeneration or extinction through that action. If such were its necessary consequences, organisms must have disappeared long ago; nay, they never would have appeared. Any organism must admit to itself, draw to itself, seek out, those conditions that are favorable to its physiological processes; this is the daily business of life. The practice of hygiene, of public health, is but one further link in a chain that goes back to the beginning of life. Amoeba covers itself with a semi-permeable membrane, admitting some chemicals, excluding others. Protective coverings become in other animals more and more efficient—the skin, hair, feathers, the heavy shell of the oyster, the armor plates of dinosaur and armadillo. Microscopic enemies that penetrate these defenses find the body fluids charged with destruction. Elaborate internal mechanisms are developed for keeping the temperature high and uniform. Strength of body, quickness, agility; the development of claws and teeth;—these seize the advantage by transforming the defensive into an offensive. Acuteness of senses, cunning, inventiveness, supplement all these methods; supply the lacks in any of them. Coöperative action registers an enormous advance. Shelters, clothes, are found or devised; fire taken into service; food cultivated; weapons invented, machines produced; the properties of substances tested; new ones compounded. Devices come into existence for recording the results of tests once made; for preserving knowledge as it is gained. Some organisms proceed to that systematic elaboration of methods for discovery and application of knowledge that we call scientific research; the most powerful aid yet devised for bringing the environment under control. Hygiene, medicine, the arts of public health—these things are but later terms in the long series that begins where Amoeba takes in certain substances and rejects others. With the other practical arts, they result in adapting the organism more and more completely to the environment. Along this road we must indeed watch for the sporadic appearance of defective genes, and these we must cancel by the only possible method — by stopping the propagation of their bearers. But defective genes are not the characteristic result of this process; degeneration and extinction are not its normal consequence. Abandonment of environmental control; cessation of the process of adapting ourselves to the conditions —this is unnecessary, undesirable, impossible. The suggestion for such abandonment is not a serious suggestion.

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PHYSIOLOGICAL DIFFERENCES IN VARIETIES

A Graphical Representation of Chemical Differences in the Tissue Fluids of Egyptian and Upland Cotton

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IN the pages of the Journal of Heredity have appeared innumerable illustrations of differences in the external characteristics of the various strains, varieties or types of domesticated plants and animals, and of the behavior of these differentiating characteristics in progenies which result from hybridization. Illustrations of the differentiation which may obtain between agricultural varieties of plants in their internal physiological or chemical characteristics have been very few indeed.

The purpose of this note and the accompanying diagram is to show the kind and amount of the difference in chemical composition which may be found in the tissue fluids of the Egyptian and Upland types of cotton when grown in the saline soils of the Southwest. Incidentally, it serves to illustrate a kind of graph which may be useful in representing the interrelationship of other characters.

The concentration of salts in the leaf tissue fluids of the cotton plant is to some extent dependent on the salinity of the soil on which it is grown. In comparing two different varieties of cotton with respect to their capacity for salt absorption it is necessary to work with plants growing under as nearly as possible the same conditions. This end may be attained by basing analyses on plants growing side by side in the field.

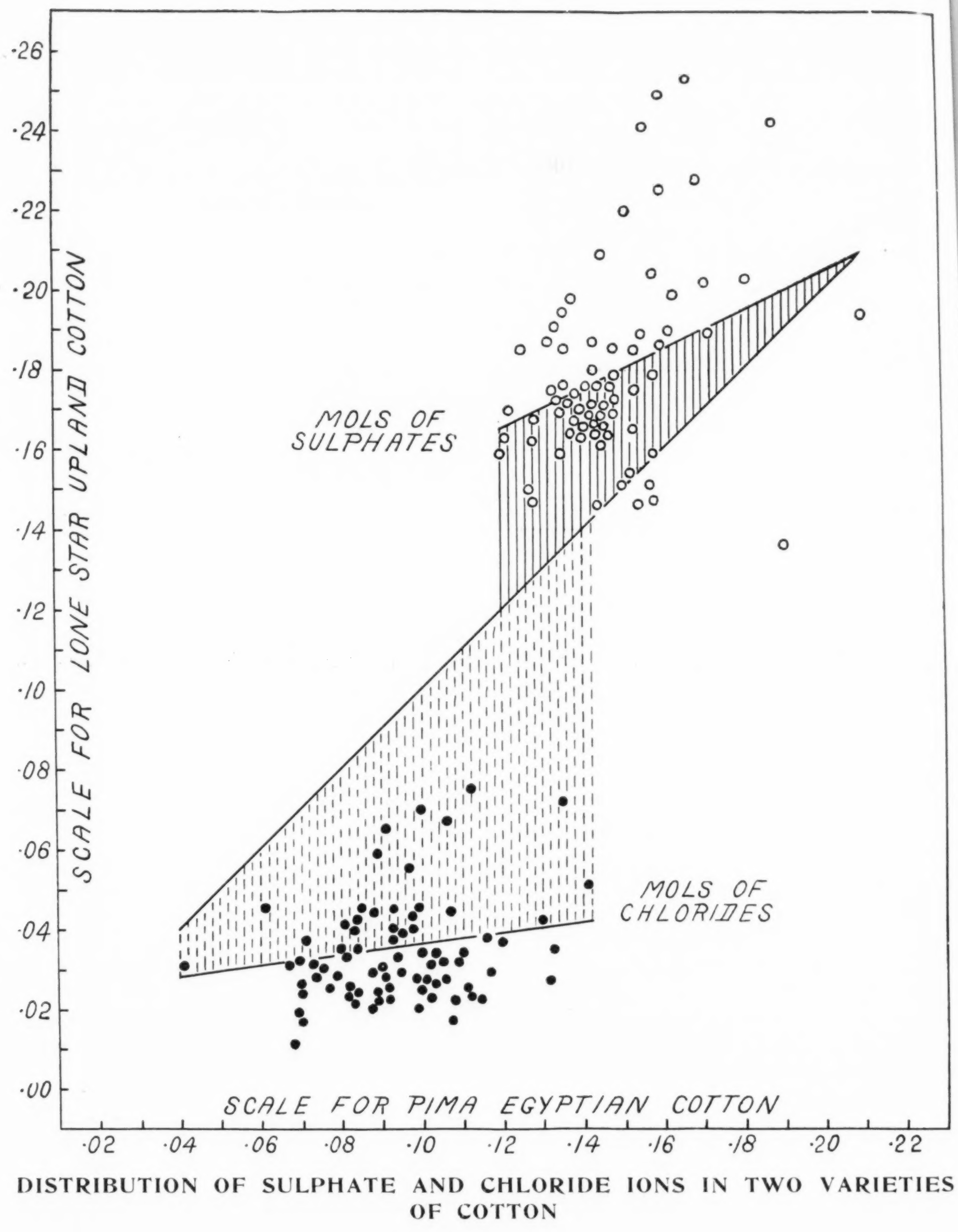
The concentrations of individual salts, or if their constituent ions, which are the units actually determined in analysis, may be expressed in terms of grams per liter, or in terms of mols per liter. The latter has the advantage of eliminating confusing differences in the weights of the different solutes.

The accompanying diagram shows the concentrations in terms of mols of chloride (Cl) and sulphates (SO_4) per liter in the leaf tissue fluids of Pima Egyptian and Lone Star Upland cotton as grown at the Cooperative Testing Station of the United States Department of Agriculture and the United States Indian Service in the Gila River valley at Sacaton, Arizona, in 1923. The figure represents the second of two series of determinations, both of which gave similar distributions.

The position of each pair of determinations of chlorides and sulphates in the leaf tissue fluids is shown by the position of the solid dots (chloride content), and circles (sulphate content) on the scale of abscissae for the Egyptian member of the pair and on the scale of ordinates for the Upland member of the pair in the comparison.

If there were no differentiation of the two types of cotton with respect to their salt contents, the solid dots and circles should be clustered about the heavy diagonal line with a slope of forty-five degrees which represents the line of equality in the salt contents of the varieties shown on the scale of abscissae and that shown on the scale of ordinates.

A glance at the figure shows that the chloride content (solid dots) is invariably lower in the Upland variety (Lone Star) used in this particular



DISTRIBUTION OF SULPHATE AND CHLORIDE IONS IN TWO VARIETIES OF COTTON

Figure 15

The position of each solid dot gives the chloride concentration of the tissue fluids of a pair of cotton plants—one a Pima Egyptian plant, and the other a Lone Star upland plant. If the concentration of chlorides had been the same in the two varieties the dots would have clustered around the heavy diagonal line. Their position indicates that the Egyptian variety has a higher chloride content than the Upland variety under similar conditions. The circles indicate in the same way that the concentration of sulphates is higher in the upland cotton than in the Egyptian variety.

The study of chemical and physiological differences between varieties and their inheritance is yet in its infancy, and it is a field that should yield very important results.

culture than in the Pima Egyptian cotton with which it is compared. The sulphate content (circles) of the Upland plants, on the other hand, is in practically every instance higher than that of the Egyptian plants with which they were in immediate association in the field.

The short lines traversing the swarms of solid dots and circles have been fitted mathematically to these analytically determined values. Their slopes show that there are slight but measurable environmental factors influencing the concentrations in associated plants in such a manner as to bring about a low correlation between them. The shaded areas between these lines and the heavy diagonal line representing equality in the salt contents of the two varieties at once convels to the eye the large differentiation of the two varieties with respect to their capacity for absorbing from the soil these two anions.

Investigations of the behavior of these differences in hybridization are now under way.

SEX AND HORNS IN CATTLE

A Note on an Exceptional Mode of Inheritance

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WHEN discussing Mendelism before a beginning class in genetics, horned and polled condition in cattle was cited as an illustration of a simple, non-linked allelomorph. Following the discussion one student, Howard Lewis, called my attention to an apparently authentic exception to the generally accepted statement involving the inheritance of horns in cattle. Unfortunately certain of the records are not as complete as one might wish. However, many of the animals are still on the farm and all the details possible to gather will be obtained at an early date. Moreover this "unplanned experiment" is still in progress and will, no doubt, be continued for some period of time.

In discussing the inheritance of horns Lloyd-Jones and Evvard* make the following statement:

"The published data on inheritance of horns in cattle are reviewed and new data presented. The present results substantiate the allelomorphic nature of the horned and polled condition in cattle, and give no evidence that sex is in any way connected with inheritance of these characters." A review of the literature cited, and of other articles bearing on this subject substantiates the conclusion drawn by Lloyd-Jones and Evvard. For this reason the case cited by Mr. Lewis should be of general interest.

Several years ago a registered Hereford bull of the Fairfax family was purchased by Mr. Lewis' father and was used upon his herd of highgrade horned Hereford females. This bull was horned, his sire was polled and his dam horned. From these matings (horned bull on horned cows) all the male calves were horned and all the female calves polled. Later a second registered Hereford bull was purchased. This animal was horned and both parents were horned. When mated with the original females only horned offspring were obtained. But when mated with the polled heifers (daughters of the first bull) all the bull calves were horned and all the females produced were polled. A third horned registered Hereford bull is now heading the herd. Similar results were obtained from these matings as in the

*In Inheritance of Color and Horns in Blue-gray Cattle, *Iowa Agricultural Experiment Station, Res. Bul.* 30, page 102A. 1916.

former instances. From the original cows only horned offspring were obtained, but from the F_1 and F_2 polled females, all the males are horned and all the females polled. Clearly, here is an instance of linkage of the horned and polled condition in cattle.

In all, about 100 animals have been produced. There were 25 polled females bred each year from the F_1, F_2 and F_3 generations. Mr. Lewis believes that the sexes were very evenly divided in numbers. In all cases the females produced from those matings were polled. Of the 10 or 12 bull calves produced each year, one or two had scurs, and when not horned always had scurs. There were no scurs on the heifers.

These records are reliable, although not as complete as desirable. This unusual inheritance was noted at the time the F_1 calves were raised. Mr. Lewis states that he and his father frequently discussed the matter and that following the development of the F_1 calves, they speculated as to the future results and that they looked forward to the calf crop each year with a good deal of interest.

An Indictment of Science

BUT what above all afflicts and hideously disfigures and deforms our fellow-creatures is Science, which brings them into relations with objects to which they are out of all proportion and distorts the true conditions of their intercourse with nature. It provokes them to understand, when it is manifest that an animal is made to feel and not to understand; it develops the brain, which is a useless organ, at the expense of the useful organs which we possess in common with the beasts; it turns us against enjoyment, for which we experience an instinctive craving; it tortures us with terrifying illusions, showing us horrors that only exist by its instrumentality: it establishes our pettiness by measuring the heavenly bodies, the shortness of life by calculating the antiquity of the world, our helplessness by leading us to suspect what we can neither see nor touch, our ignorance by bringing us up continually against the unknowable, and our wretchedness by multiplying our subjects of curiosity without supplying answers.

I am not speaking of its purely speculative researches. When it goes on to practical applications, its inventions are only new and ingenious instruments of torture, machines in which unhappy human beings are done to death. Visit any manufacturing town or go down into a mine, and say if the sights you see do not exceed all that the most ferocious theologians have imagined of Hell. Yet, on reflection, it may doubted if the products of industry are not less hurtful to the poor who manufacture them than they are to the rich who use them, and whether, of all the ills of life, luxury is not the worst. I have known people of all social conditions; I have met none so wretched as a lady of position in Paris, a young and pretty woman, who spends fifty thousand francs every year on her dresses. It is a state of things that leads to incurable neurosis.—Anatole France, *The Garden of Epicurus*, pp. 236-238. Translation by Alfred Allinson.

Such reflections are possible because most of the applications of science have been in the mechanical and industrial fields, giving us more goods but without a greater ability to use them for the enrichment of life. Even medical discoveries may be challenged on the ground that living longer is no object if we do not live better, and see that further progress can be made. Consciousness without competence gives no satisfaction, but only a painful sense of futility. The truly constructive applications of science to human welfare, through agriculture and eugenics, are still in the future.

According to the same eminent author, "Death is the most important transaction of the religious life," but asceticism is not the ideal of religion, nor is industrialism the ideal of science. Science looks to a better life in the future, but the real progress must be slow, because each step of change calls for many adjustments. Each new attainment is likely to be used destructively at first, until its functions are established by experience. Science itself, in its modern sense of deliberate search for new knowledge, still is a recent and partial attainment. The proportion of scientific minds is very small, even among the advanced nations.

O. F. Cook.

DWARFS IN SOYBEANS

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DWARF characters have been described as occurring in a number of the important crop plants, but so far as the writer has been able to learn, no true dwarf has yet been reported in the soybean *Soja max*.

In an earlier paper, Stewart and Wentz[2] presented data to show the inheritance of a recessive glabrous character, p_1, in soybeans. In this paper, it was shown that all plants posessing the glabrous character were small and undeveloped. It is probable, however, that the dwarf habit was directly due to the effect of the factor for the glabrous character, and not primarily to a factor for dwarfness.

Nagai and Saito[1] have described a similar glabrous character, P_1, which is dominant and seems to have the same effect upon the growth of the plant as the recessive type described by Stewart and Wentz.

Woodworth[3] described the inheritance of a bush character *s* in soybeans as a simple recessive. This bush type plant designated by Woodworth as type II was described as being an early maturing, bushy plant, averaging about 18 inches in height.

The author of this paper has isolated a recessive dwarf character which, from all appearance, is entirely different from any dwarf or dwarf-like character yet described. For this reason it seems desirable to present data showing something of its inheritance.

Description of the New Dwarf

This new type of plant which is being called "Dwarf" is a small, pubescent, light-green plant. It seldom reaches a height of more than ten inches, and does not possess the bushy, branching habit of growth described by Woodworth in his type II, but rather a spindly, weak appearance with only one or two short branches. It seldom produces more than four or five pods, and these usually contain but one seed each. The normal plants in the same strain, however, are large and vigorous, averaging about two feet in height and presenting a more sturdy appearance.

When the seedlings first appear above the ground, it is impossible to distinguish between the two types, but after six to eight weeks, there can be no mistake as to the proper classification. As the season advances, the differences become more evident, both in size and general appearance. The normal type is shown in Figure 17, and the dwarf type in Figure 16.

Origin

In the spring of 1924, Professor John B. Wentz turned over to the author some soybean hybrids. Among these was a seed which was supposedly a hybrid between the Habaro and Mandarin varieties. According to Professor Wentz's notes, the cross was made in the summer of 1922 by Mr. L. C. Linn.* From the seed furnished of this cross, one supposedly hybrid plant and two plants from the female parental plant of the Habaro variety were obtained. To all outward appearances, these three plants were alike, and normal for growth habit. In the spring of 1925, seeds from the supposed hybrid and from one of the female plants were planted in the field. The progeny of both plants segregated into what was apparently a 3:1 ratio for normal and dwarf plants. The following year (1926) the remaining seeds from the two plants tested in 1925, and all the

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DWARF SOYBEAN

Figure 16

Dwarf F_3 plant from the same F_2 family as the normal plant shown in Figure 17. Note the height of the plant and its spindly appearance, the absence of branches and the small leaves. This photograph is taken on a much larger scale than the one in Figure 17 as shown by the measuring stick back of the plants.

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NORMAL SOYBEAN PLANT

Figure 17

Normal F_3 plant from the same F_2 family as the dwarf plant shown in Figure 16. Note the height of this plant and its long branches which give it a vigorous, bushy appearance.

seeds obtained from the other plant of the female line were planted in the field. These seeds were likewise found to segregate for the dwarf character.

No seed from the male parent was saved, and no record other than the variety characteristics is available to show the appearance of the male plant. However, since the plant which was supposed to be a hybrid and the two plants which were supposed to be pure for the maternal characters segregated alike for the normal and dwarf habit, it follows that the cross was probably not successful, and that the original P_1 mother plant was heterozygous for the normal and dwarf characters. Beyond this, it is impossible to know definitely the origin of the character. It is possible that the original mother plant was heterozygous as a result of natural hybridization. This, however, is not likely, since none of the dwarf plants have been found in the parental variety.

Inheritance

From the seeds tested in 1925 there were obtained 92 plants. Of these, 70 were normal and 22 dwarf. From the remnant, seeds tested in 1926, 222 plants were obtained, 173 of which were normal and 49 dwarf. When all of the plants grown in 1925 and 1926 were considered together (the F_2 generation) there were 243 normal and 71 dwarf. The expected on the basis of a 3:1 ratio was 235.5 normal to 78.5 dwarfs. The deviation from the theoretical was 7.50 ± 5.18.

In 1926, 36 of the normal and 10 of the dwarf F_2 plants were tested in the F_3 generation. All dwarf plants bred true. From the 36 normal F_2 plants tested, 19 were found to be heterozygous and 17 homozygous. The expected for a 2:1 ratio was 24 heterozygous and 12 homozygous. Thus, a deviation of 5 ± 1.90 from theory was obtained.

From the 19 heterozygous F_2 plants segregating, 617 F_2 plants were obtained. Of these, 467 were normal and 150 were dwarf. The expected for a 3:1 ratio, was 462.75 normal and 154.25 dwarf; the deviation from theory being only 4.25 with a probable error of 7.25.

Discussion

From the data presented above, it is shown that this new dwarf character is recessive in inheritance to the normal. It is also shown that the inheritance is probably due to a single pair of Mendelian factors. The data in the F_2 generation and those from the normal F_2 plants segregating in the F_3, conform as closely to the theoretical as is to be expected. In the progeny test for the 36 normal F_2 plants, a rather large deviation from the theoretical is found. However, the deviation divided by the probable error is only 2.63, and since the numbers are small, the deviation is thought to be due to chance.

This new character is now being crossed with what is apparently the bush type (type II) described by Woodworth and the glabrous character described by Stewart and Wentz. From these crosses, the writer hopes to be able to establish the relationship existing between these three seemingly different dwarf and semi-dwarf types.

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IS INSANITY EVER HEREDITARY?

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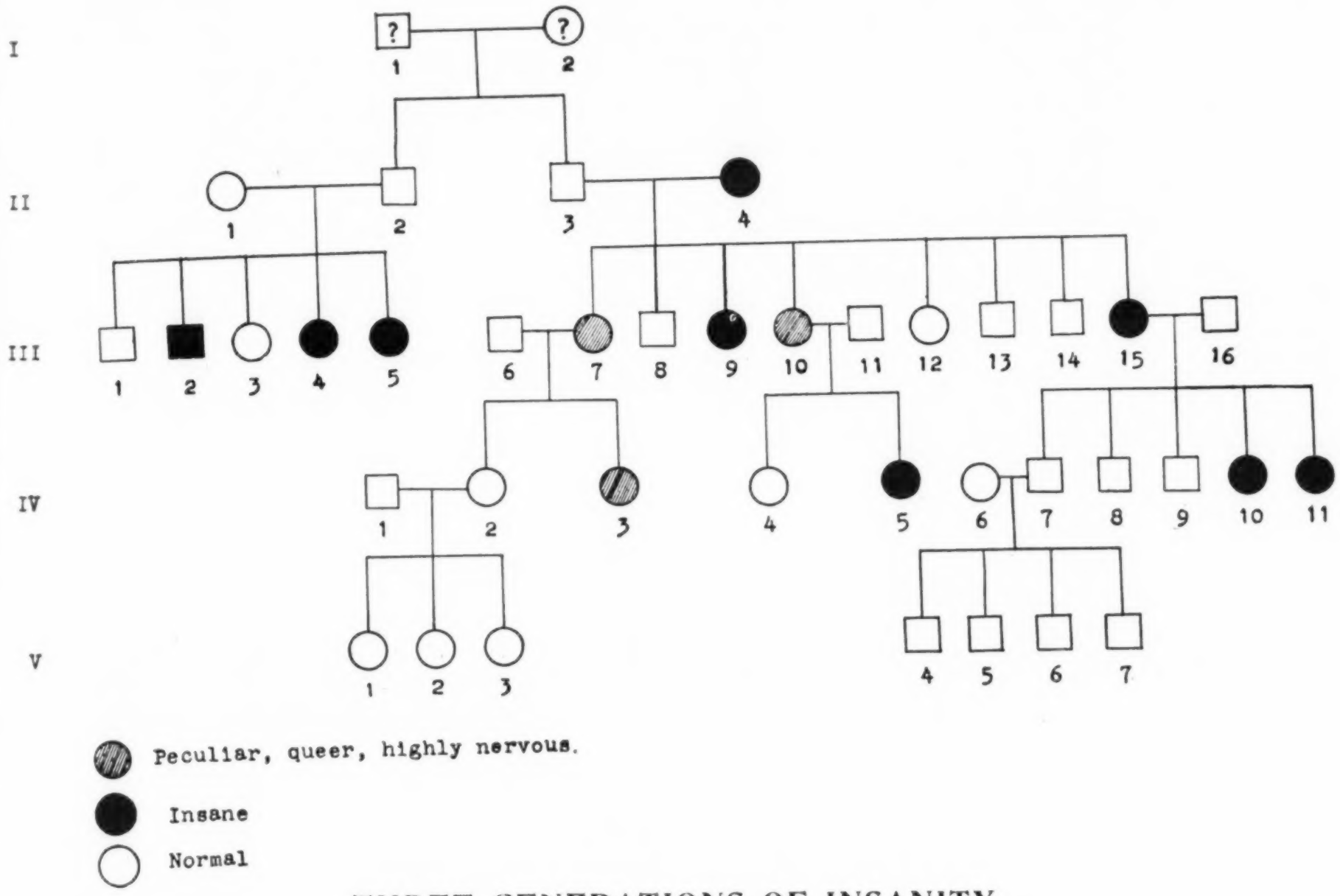

THREE GENERATIONS OF INSANITY

Figure 18

The number of insane and "queer" individuals suggest the inheritance of unbalanced mentality. Only one of the afflicted individuals is a male.

THIS family history of insanity was secured from a student in my class in Genetics and Eugenics. The student furnishing the history was one of the ablest in the class and together with her mother vouches for the facts. Although not known to be the case, the suspicion is strong that the persons supplying the history were by blood or marriage related to the family involved.

Several of the principal facts revealed by an inspection of the figure are: (1) Out of the forty individuals appearing on the chart, nine (22.5%) are insane and three are described as peculiar, queer and of a highly nervous type; (2) of the nine insane persons eight are females, and all three of the unstable "queer" individuals are females; (3) insane individuals appear in three successive generations, conditions in the first generation being unknown and the individuals in the fifth generation still in childhood. The statement was made that insanity in these persons appeared in middle life or a little later, and the impression was gained that, in general, it may have coincided with the menopause. It will be remembered that eight of the nine insane were females.

This raises the old, much fought-over question, Is insanity inherited? If so, are all the clinically recognized types of mental defect inherited, or only some of them, and if the latter, which ones are inherited and which not?

On this subject every point of view has been expressed from one extreme that insanity is due to focal infection to the view that heredity is the prime factor involved. In his *Bibliography of Eugenics,* Holmes has a section devoted to papers on the subject "Heredity of Insanity." It is interesting to note that 589 titles are included under this heading and the list is obviously incomplete. One wonders just how much less we would know about this subject if half of these papers had never been written.

In the history recorded in this note the type of insanity, or whether more than one type is represented, is unknown to the author. Neither is the chart clear as to whether this family illustrates mendelian heredity. Most forms of hereditary insanity are considered recessive, and by making certain assumptions concerning some of the normal individuals marrying into this family mendelian expectations are fairly well met. These assumptions are the stumbling block, however.

This history is offered merely as an interesting exhibit. It does not solve any problems. On the one hand it may indicate a strong predisposition to hereditary insanity; on the other it may be merely an unfortunate concatenation of focal infections ending in functional psychoses in this family.

Forerunners of Darwin

THE pre-Darwinian development of Darwinism is traced again by G. Spiller in an interesting article of twenty-one pages in *The Sociological Review* (Vol. XVIII, No. 2, April, 1926, pp. 110-130). The growth of the idea of organic evolution, the theory of natural selection as the cause of evolution, and the service that Darwin performed in collecting and presenting facts of evolution, though distinguished clearly in some parts of the article, are not consistently separated.

The collection of quotations from earlier writers includes several examples of remarkably close approximation to the views that commonly would be considered as strictly Darwinian. The array of such material renders it possible to deny that Darwin made any unique or outstanding contribution to the discovery of evolution.

> We submit, accordingly, that even the life work of the most illustrious in his famous century, when impartially examined, vindicates the specio-psychic theory of man, namely, the theory that the cultural contribution of any one individual is microscopic and that the innate capacity of human beings varies only infinitesimally. This view is in harmony with man's near filiation to the highest Primates and with the universal law of the virtual uniformity of the members of any species, and provides sociology with what is indispensable to a science—a practically unvarying and therefore calculable unit. (P. 130.)

The doctrinaire bias of such a statement is so obvious that it may destroy confidence in the article as a whole, unless it be supposed that the author had in mind only the theoretical features of Darwinism, rather than the status of evolution, as affected by the publication of Darwin's books. Whatever the value of his own contributions of ideas or of facts, it would seem impossible for any historical student to overlook the effect of Darwin's writings in bringing the facts and applications of evolution to the attention of the world.